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ABSTRACT

The book, second in a series concerning the habilitation of the severely and profoundly retarded, was compiled to facilitate rapid professional dissemination of reports from the Specialized Training Program at the University of Oregon. Titles and authors in the section "Issues in Habilitation" include "Vocational Training and Production Supervision--A Review of Habilitation Techniques for the Severely and Profoundly Retarded" (G. Bellamy et al), "A Conceptual Analysis of Vocational Training with the Severely Retarded" (R. Horner, G. Bellamy), "Accountability in Habilitation of the Severely Retarded--the Issue of Informed Consent" (R. Horner), and "Habilitation of the Severely and Profoundly Retarded--An Applied Research Perspective" (G. Bellamy, L. Irvin). Those in the section "Evaluation of Habilitation Procedures" include "Stimulus Control, Transfer and Maintenance of Upright Walking Posture with a Severely Retarded Adult" (R. Horner), "Workshop Supervision--Evaluation of a Procedure for Production Management with the Severely Retarded" (G. Bellamy, et al), "Evaluation of a Procedure for Teaching Saw Chain Assembly to a Severely Retarded Woman" (C. O'Neill, G. Bellamy), "Considerations in Dealing with Low Production Rates of Severely Retarded Workers" (R. Horner et al), and "Effectiveness and Generalization of Overcorrection Procedures with Stereotyped Behavior of a Severely Retarded Adult" (H. Rose). Titles and authors in the section "Related Research" include "'Operations' in Vocational Training for the Severely Retarded" (G. Bellamy et al), "Utility of an Instrument for Assessing Labels Used to Describe Retarded Adults" (G. Bellamy, L. Irvin), "Evaluation of a Procedure for Teaching Generalized Tool Use Skills to a Severely Retarded Person" (N[illegible] Brill), and "Long-Term Retention of Vocational Skill Training by Severely Retard[illegible]ndividuals" (L. Irvin, G. Bellamy). (DLS)

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HABILITATION OF THE SEVERELY AND PROFOUNDLY RETARDED:

Volume II

REPORTS FROM THE SPECIALIZED TRAINING PROGRAM

Edited by
G. Thomas Bellamy
Robert H. Horner
Dean P. Inman

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University of Oregon

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Within the University of Oregon our work has been conducted in an exceptionally supportive environment. Dr. Robert H. Schwarz, Director of the Center on Human Development, has combined good planning and good promotion with a thorough understanding of our program development objectives and strategies. We have also been fortunate in the cooperation offered by the Research and Training Center in Mental Retardation at the University of Oregon. Dr. Larry Irvin and Dr. Andrew Halpern have supported a variety of collaborative research efforts in which the interests of our two projects have coincided.

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Finally, our appreciation is due the severely retarded adults in Eugene, Seattle, and Reno who are teaching us how to teach and continually reminding us that we still have much to learn.

Foreword

In this second of a series of books concerning the habilitation of the severely and profoundly retarded, Bellamy, Horner and Inman have extended the research reported in Volume 1. The papers that comprise the book are all, in some way, related to the ongoing research and training conducted in the Specialized Training Program at the University of Oregon. It is clear that no compilation of readings can cover the broad range of tasks to be done if this population is to assume an appropriate role in our society. Nevertheless, the implications of this material should alert the reader to consider habilitation in a systematic manner and should serve as a stimulus for further experimental research as well as the extension of graduate and inservice education.

During this past decade we have witnessed several efforts to extend services to those who are more severely involved. Terms such as deinstitutionalization and normalization have come to the fore, and professionals charged with implementing these concepts have become fully aware that there is no easy way to provide normal opportunities and experiences. We have just begun to recognize the true potential of the handicapped.

Progress may come in small increments but those involved in the Specialized Training Program have developed procedures that have enabled them to make significant differences in the lives of some severely handicapped people. Further, they support these procedures with data. As Lord Kelvin pointed out, "One's knowledge of science begins when he can measure what he is speaking about and express it in numbers." While this has been done in the program and described with clarity in the papers, it is apparent that the overall effort is accomplished within a framework of genuine feeling for those who are less able.

Although this book will be of most interest to professionals in the field, it can only be hoped that the ultimate beneficiary will be the handicapped person who suffers less impairment because others extended their capabilities.

Robert H. Schwarz, Ph.D.
August 1977

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Preface

This is the second of a series of research monographs compiled to facilitate rapid professional dissemination of reports from the Specialized Training Program at the University of Oregon. The Specialized Training Program is an applied research and demonstration project designed to increase vocational opportunities for severely and profoundly retarded adults in the Pacific Northwest. Since 1973 the program has operated a small community workshop and has worked within that shop to develop and apply practical habilitation techniques for severely retarded individuals.

The first monograph (Bellamy, Note 1) illustrated the empirical process of developing these habilitation techniques. Like most vocational programs the Specialized Training Program workshop was faced with the tasks of teaching vocational skills, performing task analyses, supervising production, and teaching other behaviors to facilitate community living. Techniques were identified or developed for each of these aspects of habilitation. A single subject research strategy was used to assess the utility of various techniques in the workshop, and the relative efficiency of some treatment options was studied in other non-treatment settings as well. The compelling conclusion from the papers presented in the first monograph was that practical habilitation techniques for habilitation of many severely and profoundly retarded persons are available. This conclusion is consistent with the results of several current research and demonstration efforts involving similar populations (Gold, 1976; Karan, Wehman, Renzaglia, & Schutz, Note 2; Lynch, Note 3; Martin & Flexer, Note 4; Rusch, Connis, & Sowers, Note 5).

The research presented in this second monograph was motivated by both the successes and the failures of previous habilitation efforts. The successes, if they are taken seriously, prompt inquiry about the nature of habilitation services from which severely retarded persons are often excluded and the possible nature of a service system which could include them. Treatment problems or failures have also prompted extensive study. We have interpreted failure to meet a habilitation objective as a failure of the technique or treatment specialist, and not a failure of the severely retarded worker. As such, individuals whose learning or performance has been problematic have been the focus of more precise evaluations of our treatment efforts.

Part One of the monograph reflects our interest in the implications of habilitation successes with the severely retarded. Papers are included which describe the empirical basis and breadth of available techniques, list some applied research needs, explore implications of some educational research, and analyze relevant legal concepts. Clearly, this work is only a beginning. The continuing discrepancy between results of published demonstration programs and currently available service options for most severely retarded adults should prompt continued analysis of such issues. In particular, it seems that effective integration of available techniques into existing service systems will be facilitated by (a) critical empirical analysis of habilitation techniques used with the severely retarded, (b) articulation of comprehensive habilitation strategies which combine techniques that have been effective, and (c) careful analysis of the service context within which those strategies will be implemented.

Additional accounts of the research basis for habilitation techniques are provided by Gold (1973) and Martin and Pallotta (in press). Several research groups are now working to define comprehensive service models which facilitate delivery of service to the severely retarded. The reader is referred, for example, to the Specialized Training Program model described by Bellamy, Inman, and Horner (in press), the systematic work evaluation and training model described by Fox and Karan (1976) and Gold's (1973, 1976) procedures for teaching vocational skills. Several important reviews of current rehabilitation services also are available. Readers interested in developing vocational habilitation options for the severely retarded might be interested in the national workshop surveys conducted by the U. S. Department of Labor (1977) and Greenleigh Associates (1975). Additional helpful information is provided in the comments of Pomerantz and Marholin (1977) on restrictions within the current service system, the survey of disability groups served in Michigan workshops and activity centers (Lynch & Graber, 1977) and Laski's (Note 6) legal research on service entitlement of developmentally disabled adults.

Part Two of the monograph illustrates our study of individuals who presented difficult habilitation problems in that their behavior was very discrepant with behavioral expectations in vocational or community settings. In his review of behavior analysis applications with retarded persons, Kazdin (1973) noted that a few individuals apparently have been unaffected by many well-planned behavioral treatments. This is consistent with our experience in providing vocational services and with other vocational training research (e.g., Bellamy & Irvin, 1976; Gold, 1972). In our view these treatment problems, whether they reflect failure to acquire skills in structured training or failure to perform them adequately after training, provide a unique opportunity to refine habilitation procedures. Therefore, much of our research in habilitation techniques has involved extensive study of individual subjects for whom initial treatments were ineffective. Following Sidman's (1960) suggestion, we are proceeding on the assumption that our general approach to habilitation will be improved *inductively* as a result of studying single individuals across situations and across treatment problems.

Perusal of Part Two of the monograph suggests correctly that the most persistent problems with which we dealt during the last year related to stimulus control and generalization. A technology for changing many vocational and social behaviors of severely retarded persons has been available for some time (e.g., Crosson, 1967; Martin and Pallotta, in press). However, behavioral changes often have been studied in limited or contrived settings and thus fall short of a criterion of ecological significance that has been proposed for research on mental retardation (Brooks & Baumeister, 1977). Ecological significance implies importance for everyday functioning. It points to the need for techniques not only to change behavior but also to insure that the new performance is functional in the individual's environment. This typically involves systematic transfer of stimulus control over desired behavior to events in the individual's natural environment. The papers in Part Two document some of our attempts to insure that treatment and training gains are ecologically significant.

The final part of the monograph reflects our interest in extending the emerging technology of habilitation to related service efforts. The expansion of public school programs for the severely handicapped has created the possibility of teaching many vocational skills prior to an individual's entry into rehabilitation programs. It thus seems important to ask what skills might be taught in school settings to facilitate later performance in the work setting which we now know could include the severely retarded. The programming strategies of Becker, Engelmann and their associates (Becker, Engelmann, & Thomas, 1975) have influenced our initial questions in this area.

A second general area of research interest has been that of program evaluation. As we have attempted to evaluate the effectiveness of programs which utilize the Specialized Training Program Model, a significant need has been apparent for instrument development. The success of a vocational program for the severely retarded, might be best evaluated not just by vocational performance, but also by other effects on an individual's daily life. The naturalistic observation codes presented in the first monograph reflected one method of assessing these more general program effects. The adjective checklist in this volume is another. Because currently accepted values and treatment objectives (Roos, 1975) imply a variety of outcomes in successful programs, our instrument development efforts have focused on ways to supplement widely used ratings of skill development like the Adaptive Behavior Scales (Nihira, Foster, Shellhaas, & Leland, 1974).

As a whole, the monograph is an effort to disseminate the empirical basis for developing vocational programs for the severely retarded. As more severely retarded individuals live in community residences rather than institutions, expansion of some daily services to them seems likely. By documenting procedures, results and implications of our habilitation efforts, we hope to influence community programs to provide more vocational opportunities to the severely retarded.

G. Thomas Bellamy
Robert H. Horner
Dean P. Inman
August, 1977

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PART I

Issues in Habilitation

Vocational Training and Production Supervision: A Review of Habilitation Techniques for the Severely and Profoundly Retarded

G. Thomas Bellamy, Dean P. Inman, and Robert H. Schwarz
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Vocational Training and Production Supervision: A Review of Habilitation Techniques for the Severely and Profoundly Retarded

Legal decisions and parental pressure have led to an emerging national commitment to appropriate education and training for all handicapped individuals. Carried to its logical conclusion this philosophy should result in a significant increase in the services available to severely handicapped adults. Decisions regarding the right to treatment within institutions (Wyatt vs. Aderholt, 1971) and the present emphasis on deinstitutionalization suggest that communities must be prepared to offer daily vocational, educational, and recreational programs to adults in need of specialized services. A strong emphasis on vocational opportunities in these programs will reflect the significant role of work in our society and will be consistent with professional interest in both normalization and individual development.

Among those most immediately affected by the press toward deinstitutionalization are the severely retarded. For them, a changing array of potential community services offers some promise that the gap between research results and traditional expectations may be narrowed. This situation appears to have generated considerable interest in a more thorough examination of research and practice relating to the development of vocational opportunities for severely and profoundly retarded adults. Thus, while the material reviewed in this chapter may be relevant to other groups labeled severely handicapped, it is unlikely that it will be as complete for them.

The assumptions and values with which a body of knowledge is approached often have much to do with both the questions which are posed and the conclusions which are drawn (Kuhn, 1962). In this discussion of the vocational habilitation of the severely and profoundly retarded, retardation will be viewed as a problem of behavioral deficits which can be remediated through adequate environmental programming, rather than as an irreversible condition arising from an impaired intellectual functioning (Bijou, 1963; Lindsley, 1964; Meyerson, Michael, Mower, Osgood & Staats, 1960).

For some time prevalent views of severe and profound retardation have included a notion of limited potential, a belief that retardation causes or is necessarily associated with an inability to perform a variety of normal activities like communicating with others, taking care of personal needs, living in the community, and participating in vocational opportunities. Following the numerous demonstrations of the acquisition of skills, many of these assumed limitations are being discarded by both professional and public groups. Nevertheless, the belief in limited vocational potential has proven to be resilient. Adult programs continue to be established "for handicapped clients whose physical or mental impairment is so severe as to make their productive capacity inconsequential" (Federal Register, 1974, p. 17509).

As has been the case with other skill areas, a growing research literature suggests that the concept of limited vocational potential so often assigned to retarded persons should be replaced with a recognition of the possibility of vocational competence after structured training. There are numerous reports that adults, who clearly fall within the AAMD definitions of severe and profound retardation (Grossman, 1973), are able to learn a variety of vocational skills. For example, Loos and Tizard (1955) were able to train six "imbeciles" to fold and glue together cardboard cake boxes. Then Clarke and Hermelin (1955) taught these same adults to cut insulated wires to exact length, to solder four colored wires to color coded terminals of an eight-pin television plug, and to complete a nine-component bicycle pump assembly. After a lapse of more than a decade and with roughly the same population of retarded adults, other studies have reported similar results in teaching such skills as stripping and sorting plastic components (Williams, 1967), manufacture of wooden pencil holders and flower baskets (Crosson, 1967, 1969), assembly of a 12-piece bicycle brake (Gold, 1974), assembly of 24- and 26-piece printheads and assembly of a 52-piece cam switch actuator (Bellamy, Peterson, & Close, 1975), bagging garlic bulbs and labeling them for commercial sale (Friedenberg & Martin, 1977), and construction of a difficult cable harness (Hunter & Bellamy, 1976). Thus, over a 20-year period the work potential of this population has been repeatedly demonstrated.

Taken together, these demonstrations provide a realistic basis for questioning whether it is useful to associate various levels of retardation with assumed limitations of individual potential for vocational and/or other behavioral skills. In fact, the research does much to support the contrasting view of retardation which provides the framework for this review. Deficit vocational behaviors imply a need for improved environmental programming, not a limitation on a retarded person's work potential. The salient question now facing habilitation specialists is not whether severely and profoundly retarded adults can be taught the skills necessary to function independently in a vocational setting, but rather how best to teach these skills.

From this perspective, if a profoundly retarded adult is unable to function in a vocational setting, there are at least two possible explanations. First, the worker may not have the necessary skills to fulfill the job requirements. Such a deficit can result from a lack of necessary response topographies or a deficit in stimulus control that makes a worker unable to satisfy the contingencies in a particular work setting. For example, if a task requires a worker to use a screwdriver and the worker does not know how to hold and twist the tool, then s/he will be unable to complete the task satisfactorily. To overcome this type of problem, the worker must be taught the necessary response topographies. However, even if a worker has the topographies to use a screwdriver, if s/he fails to stop twisting the screwdriver when a screw becomes snug, the threads may become stripped or the head fouled. That is, the worker may not be sensitive to critical changes in the work environment. The solution is to provide training specifically designed to establish stimulus control; i.e., to bring appropriate response topographies under control of task-related stimuli.

A second explanation for vocational incompetence may involve an inordinately low work rate. That is, a worker could have the necessary response topographies and be under sufficient stimulus control so as to complete the task without errors, but if the rate of production is grossly inadequate, it is unrealistic to place the individual in a normal work environment. To overcome this type of problem, environmental programs must be designed to increase work rate to an acceptable level.

The present review discusses the problems of skill acquisition and work rate which contribute to vocational incompetence in severely and profoundly retarded adults. Specifically, the following section examines training techniques to alleviate skill deficits. The subsequent section deals with production supervision techniques which increase work rates.

Techniques for Vocational Training

In view of the gap between popular expectations regarding what severely and profoundly retarded adults are capable of learning and what they actually can do when given proper instruction, it seems prudent to review the literature to determine how others have managed to overcome what must have been difficult teaching problems. Therefore, this review of training techniques describes how several vocational tasks were taught, although many aspects of the training procedures are not described in the published reports.

Loos and Tizard (1955) were faced with teaching six retarded males, whose IQ's ranged from 24 to 41, to fold cardboard cake boxes, a job requiring nine discrete movements to be made with "both hands, neatly and in a specific order" (p. 397). However, before formal training started, each subject was taught "to fold." (As will be discussed later, this constitutes what Becker (1971) refers to as teaching an operation.) According to Loos and Tizard, vocational training involved:

> No unusual techniques of training. . . . Rather the boys were first shown how to do the job and coached singly for about an hour. The group then worked under the supervision of the experimenter for a fortnight. When a patient failed to do the correct things in the correct order he was made to begin again and go through the whole sequence of movements correctly. (p. 397)

In a subsequent study Clarke and Hermelin (1955) were able to teach these same adults three industrial-like tasks: (a) a task requiring the use of a guillotine to cut an insulated wire to exact length (∓¼″), (b) a soldering task in which four different colored wires were soldered to the correct terminal of an eight-pin television plug, and (c) a simple bicycle pump assembly task requiring nine different operations. Training on the first task involved explaining the task sequence, twice demonstrating (modeling) the proper sequence, then letting the worker cut five wires as practice, and finally "helping and correcting as necessary" (p. 338). It is not entirely clear how the second task was taught but apparently the trainees were assisted (primed) through the task until they could perform the soldering task unaided. In the third task workers were given "one demonstration of the assembly and then aid[ed] to follow the experimenter in each operation" (p. 339).

In a much more recent report Williams (1967) was able to train a single male, labeled profoundly retarded, to strip plastic components by initially "holding [the worker's] hands and forcing the action of pulling apart until he began to dislike this physical coercion so much that he did it himself" (p. 17). Then, evidently, various other sorting tasks were taught in the same fashion though specific information is not given about how these simple operations were taught. Crosson (1967, 1969) successfully trained seven severely retarded adult males to complete one task requiring the use of a drill press to make wooden pencil holders and a second task involving the use of a hammer to build flower boxes. The first step in the training program was to specify the component parts of each task, i.e., the "functionally integrated units of behavior (operants) making up [the] response sequences" (1969, p. 814). Then, once the operants had been identified, the task was further analyzed to determine which stimulus cues were associated with each operant. Actual training was conducted by providing a demonstration "of the component behaviors in their proper sequence" (p. 815) and immediately prompting the trainee to imitate the modeled response. Immediate reinforcement, in the form of praise, candy and tokens, was delivered contingent upon the worker emitting the correct movement in the presence of the appropriate stimulus. In the final stages of training extrinsic reinforcers were faded out as were all other verbal cues or physical primes used in the early stages of training.

Bellamy, Peterson and Close (1975) trained two profoundly retarded adults to assemble a 19-piece cam switch actuator. The trainee was seated in front of a work tray, similar to that described by Gold (1972), where all the required parts were arranged in the order of use. The trainer then modeled each new step of the task after which the trainee was expected to perform that step without assistance. When correct responses were emitted, reinforcement (in the form of praise, edibles, or physical contact) was delivered immediately. Incorrect responses were followed by a correction procedure where "The trainer provided assistance with a verbal direction, model, or physical prime. . . Then asked [the worker] to repeat the step" (p. 12).

Friedenberg and Martin (1977) trained two severely retarded men to place garlic bulbs into plastic bags and then staple on labels so the items could be sold in grocery stores. In the author's own words:

> The trainer began by physically modeling the steps necessary to obtain a completed product while stating verbally the operations he was performing according to the task analysis. He then told the student to try the task. An inability to complete a step correctly was dealt with first by a non-punitive indication of error ("Try it another way"). If this had no effect, a verbal direction was given such as "hold the bag tightly." If the verbal instruction did not result in the subject correcting his error, a physical cue was given in the form of the step being modeled by the trainer with accompanying verbal instructions. The fourth level of correction (priming) consisted of manipulating the subject's hands to help him complete the step correctly. No tangible reinforcement was given (p. [illegible]7).

Hunter and Bellamy (1976) trained three severely retarded adults to construct an eleven-wire cable harness laced with a continuous elastic cord so it would retain its original shape when installed in an oscilloscope. First, a detailed task analysis was performed. Training consisted of one-to-one instruction beginning with a single demonstration of each step in the task. After that, the trainee was given the opportunity to complete each step on his/her own. When close approximations were emitted a variety of reinforcers were given including edibles, compliments, and money. Incorrect or unacceptable responses were consequated by a correction procedure in which the trainer either modeled the correct response and/or physically primed the worker through the correct response. The trainee was then given another opportunity to emit an acceptable approximation.

Another series of vocational training studies deserves particular attention, although most of the published reports focus on adults labeled moderately retarded. In a series of studies of assembly skill acquisition, Gold and his coworkers (Gold, 1972, 1974; Gold & Barclay, 1973a) have developed efficient training procedures for assembly of two bicycle brakes. In these studies, training began by seating a worker at a table upon which lay a compartmentalized tray with parts enough to complete four entire brake assemblies. Then the trainer would give one demonstration showing correction and reinforcement procedures, i.e., the trainer brought forward each part, placed it within the appropriate compartment, and then assembled the entire unit. During the demonstration, "Errors were made, according to a standardized demonstration format, and verbal cues that would be given when the subject made an error were used. The most frequently used cue was, 'Try another way' " (1972, p. 7). Furthermore, "To correct manipulation problems it was sometimes necessary to give more verbal assistance" (p. 8). After a successful correction procedure the verbal response "Good" was given and the same cue was given at the end of each trial. More recent reports have noted the utility of these techniques with other tasks (Levy, 1975) and with more severely handicapped individuals (Gold, 1975).

Of particular importance in Gold's work is the systematic comparison of the relative effects of variations in training procedure on measures of training time, retention, and transfer. Moderately retarded subjects learned to assemble a bicycle brake faster when permanent color cues highlighted discriminations in assembly (Gold, 1972). However, when these cues were used as a training device and removed, so that ultimate performance was on the unmarked brake, acquisition was no more efficient than with direct training (Gold, 1974). In another comparative study in which procedures involved altering features of the work task itself, Gold and Barclay (1973b) taught a bolt sorting task involving a difficult length discrimination (a difference of ⅛ inch between the two bolts). Teaching involved one of two methods, simple differential reinforcement, and training on progressively more difficult discriminations, beginning with bolts which differed ¾ inch in length, and continuing until the original task was learned. The latter procedure was more efficient.

Another comparative study further explored the issues raised in the Gold and Barclay (1973b) results. Irvin and Bellamy (1976) taught three groups of severely retarded adults a simple assembly task involving a difficult visual discrimination (distinguishing between 2 sides of a hex nut, one of which was raised .10 cm). Each of three training conditions involved manipulation of stimulus features of the task, so that an easy discrimination could be taught first; then these stimulus changes were gradually removed until the criterion task was learned. Stimulus feature changes involved addition and reduction of large cue differences on the relevant dimension (the convex face of the nut was exaggerated); adding and fading redundant color cues; and a combination of these. With this task, the combination resulted in the most efficient learning, with the color cues ranking second.

In its entirety, this collection of vocational training studies reflects considerable variation among professionals as to how vocational skills should be taught to severely and profoundly retarded adults, and some differences in how training procedures are conceptualized and described. In spite of these ambiguities, however, three things seem clear. First, there are various techniques or teaching methods that "work" in the sense that they serve to functionally improve vocational skills in severely and profoundly retarded adults. Second, low IQ scores do not preclude acquisition of difficult vocational tasks. Third, it appears that successes enjoyed to date are highly correlated with the fact that planned training programs were used in which tasks were broken down into their component parts and then taught to the workers directly.

Some Practical Techniques

During the past 20 years various teaching techniques based on behavioral theory have evolved which, when systematically applied, make good use of whatever potential a learner brings to the learning situation. In this section, a few of the most frequently used techniques for direct vocational training are discussed.

Problems in Response Topography

There are at least four basic methods that can be used to teach new response topographies or to improve the quality of responses already in an individual's repertoire. Though each is listed below as a separate technique, actual training usually involves the use of two or more simultaneously.

1. *Shaping.* This basic procedure is used to improve the quality of an overt response by differentially reinforcing successive approximations until the individual reaches a criterion level of behavior. That is, reinforcement is delivered contingent upon responses that more and more closely approximate the desired behavior. As training proceeds, i.e., as the trainee learns the task, the criterion for reinforcement goes up accordingly. In addition, when shaping a new motor skill the trainer has the choice of (a) waiting for the learner to emit approximate responses on his/her own (which, strictly speaking, constitutes a "pure" shaping paradigm) or (b) attempting to evoke superior approximations by assisting the learner in one way or another. In either case, it is understood that as the responses become more task specific they must be differentially reinforced to improve the topography (quality) over time.

The advantage of using a pure shaping paradigm is that, with the significant exception of the presence of a trainer, the learner is not exposed to superfluous discriminative stimuli (stimuli not normally present in the production setting) during training. This means there will be no subsequent need to transfer stimulus control, via fading procedures, before the worker can work independently in a production setting. But by the same token, a pure shaping paradigm may have a marked disadvantage in that it requires the trainee to emit reasonable approximations on his/her own, a process that may involve considerable waiting on the part of the trainer. In fact it is usually for the sake of saving time that most trainers argue for using "extra support" in the early stages of training. The contention is that by intervening they can get the trainee to emit fairly close approximations without delay. This not only speeds acquisition of new response topographies but it also avoids emotional reactions on the part of the trainee due to a history of "wrong" or unsatisfactory responding.

The remaining three techniques involve the provision of additional information prior to the trainee's response in order to maximize the probability that the desired response topography will be emitted. Each of these techniques relies on the application of shaping principles as well. Specifically, they all begin with a low criterion for reinforcement, and as training proceeds the criterion level for reinforcement is gradually raised. Problems inherent in fading out trainer assistance are treated separately in the next section dealing with problems of stimulus control.

2. *Physical priming.* Whereas a pure shaping paradigm requires the trainer to wait for the learner to make increasingly better approximations on his/her own, physical priming involves physically holding and then moving the trainee through the desired motor response. This technique allows the trainee to experience very close approximations to the criterion response without having to suffer through what might be a lengthy period of incorrect respond-

ing after which there is no reinforcement. Further, it may avoid periods of long pausing that may well slow down training and subsequent production to the extent that "pausing" becomes a discriminative stimulus correlated with a superstitious chain consisting of a pause, a correct response, and then reinforcement. As mentioned above, the problem with this method of teaching new response topographies is that "correct responding" often comes under control of being held or touched by the trainer, since in the early stages of training this stimulus condition often sets the occasion for reinforcement. Transferring stimulus control to stimulus conditions associated only with the task can be a difficult problem. In general, as with any kind of trainer-assisted instruction, physical priming should be used with the idea of eliminating the primes as quickly as possible. The longer they are used, the more difficult the withdrawal.

3. *Modeling.* On some occasions it may be possible to teach a skill by having the learner watch while the trainer demonstrates the correct motor response or a component of it. This procedure is usually adequate with individuals who can reliably imitate the trainer's demonstration. However, it is less likely that it will suffice, without prior imitation training, to teach vocational skills to many severely or profoundly retarded adults. One positive aspect of this technique is that a modeled response can lead to fairly good approximations after which it may be comparatively easy to further refine the response topography by shaping.

4. *Verbal directions.* As was the case with modeling, verbal instructions about the behaviors required by a task or the necessary discriminations may be sufficient to occasion correct responses from many individuals. This technique, however, is unlikely to be effective with the more severely retarded. Nevertheless, some data are available which suggest that the systematic use of verbal cues can facilitate acquisition by individuals whose language ability can be questioned (Gold & Barclay, 1973a).

A useful conceptual framework emerges when these last three techniques which involve trainer assistance are analyzed. Verbal directions, modeling and physical priming will be effective teaching techniques only to the extent that they provide useful information to the trainee, i.e., increase the probability of desired response topographies so that successive approximations can be reinforced. If, in fact, these sets of stimuli (teaching techniques) function as effective discriminative stimuli for the desired reponses, the trainee may be said to have an operation. According to Becker (1971), "Operations are the essential *response* characteristics shared by a set of responses in a given universe of operations. *Instances* are to a *concept* as *individual responses* are to an *operation*" (p. 413). For example, a trainee would be expected to improve the topography of a desired response after the response was modeled only if some form of a generalized imitation skill was present. Similarly, verbal and physical cues will be effective only if the trainee has a generalized skill of following these cues with appropriate matching responses. A key issue in the efficacy of vocational training would thus appear to be the extent to which necessary operations are in a trainee's repertoire. Considerable attention has been paid to teaching generalized imitation skills to severely handicapped adults, but other operations have received less attention. An important exception is the work of DeBriere (Note 2) who taught severely handicapped adults a generalized skill of following picture cues in small parts assembly. Continued research is needed to evaluate the relative efficiency of direct training on individual tasks and prior training to establish some of these generalized skills, or operations, which could facilitate future learning.

Problems in Stimulus Control

Generally speaking, as a worker proceeds with a task, the stimulus characteristics associated with that task change accordingly, i.e., as something is put together it looks and feels different at each step in the chain. Ideally, these distinctive stimulus characteristics should function to inform the worker what to do next. If a worker has not learned which stimuli set the occasion for a particular response then some way must be found to teach these critical discriminations. To achieve this goal there are several ways to arrive at what behavior analysts call stimulus control. But, varied as these are, they all aim at getting the worker to attend to, i.e., respond as a function of, critical changes in the stimulus aspects of the task at hand.

In general, there are three practical techniques that can be used to improve stimulus control.

1. Differential reinforcement. This method for establishing stimulus control involves reinforcing, immediately if possible, all members of a specified response class in the presence of a defined stimulus condition. Non-instances as well as instances emitted outside the appropriate stimulus condition are never reinforced, i.e., they are extinguished.[1] A program using differential reinforcement will teach a worker what must be done and when, providing the program is carried out in a systematic fashion *and* providing the worker is able to determine what are and are not relevant stimulus dimensions.

In many discrimination problems differential reinforcement is either an ineffective teaching method or is inefficient in terms of both training time required and number of errors made (Gold & Barclay, 1973b; House & Zeaman, 1960; Sidman & Stoddard, 1967). For these problems two other general approaches are available, each of which relies on the use of differential reinforcement plus some additional changes in the antecedent stimulus conditions.

2. The first of these procedures involves manipulation of stimulus features of the task in order to accentuate the relevant dimension to which the trainee must attend and respond differentially. This may involve either adding and then gradually reducing large cue differences on the relevant dimension or adding and fading a redundant dimension which has a high degree of salience for the trainee. In either case the purpose of these stimulus feature manipulation approaches is to establish stimulus control over the trainee's behavior, then to gradually remove the added cue information until the original task occasions correct differential responding.

3. The other general antecedent-related method of establishing stimulus control involves gradually fading trainer assistance. As was noted above, the trainer can often increase the probability of correct responding by providing verbal instructions, models of the response, or physical primes. As this assistance is gradually faded, the trainee's behavior is usually expected to come under the stimulus control of the task. Fading may involve gradual reduction in the amount and specificity of information, as in replacing a direction like, "The raised side goes up," with a less informative direction such as, "Try again," or in replacing a complete model of the response with a simple demonstration of the initial hand position. Another fading approach involves gradually increasing the latency between presentation of the necessary trainer cue and the appearance of the task-provided discriminative stimulus. That is, the instruction, "The raised side goes up," might at first be given as the trainee picks up the part in question. Then, in later training trials the time interval between the instruction and the opportunity to perform the step could be

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[1] Particularly good examples of this approach are described by Crosson (1967) and Screven, Straka and LaFond (1971).

lengthened while the trainee continues to respond correctly to the characteristics of the part itself.

Whichever method of establishing stimulus control is used, a special circumstance is encountered in many repetitive work tasks. When work involves repeated progression through a set sequence of behaviors, conceptualization of a single work cycle as an operant chain can be useful. Basically, a chain is a specified series of responses, each of which is associated with a unique stimulus condition. In turn, each salient stimulus condition should function in two ways: first, each discriminative stimulus (except for the very last) should set the occasion for the subsequent response in the chain, and second, each should function as a conditioned (or secondary) reinforcer for the previous response(s). (For a detailed analysis the reader is referred to Kelleher, 1966.) Theoretically, this situation is what maintains a response chain until the very last response is emitted which, instead of leading to another discriminative stimulus, sets the occasion for reinforcement in the form of praise, tokens, money, etc.

The training issue is how to teach such a sequence of responses most efficiently, so that the dual function of the associated stimuli is established and subsequent responding is free of pauses and errors. Both forward (e.g., Gold, 1972; Hunter & Bellamy, 1976) and reverse (e.g., Screven, Straka & LaFond, 1971) chaining techniques have been used with success. The relative merits of the two procedures and their possible interaction with various task characteristics need more investigation.

The present review has shown the utility of viewing vocational skill deficits as a problem of training rather than as evidence of limited potential. From this, one thing now seems clear. Although questions still remain as to what are the most effective methods for teaching vocational skills, the questions now facing us are amenable to empirical investigation. Only more time and effort are needed to solve these seemingly complex issues.

Techniques for Supervising Production

The practical utility of work skills acquired by severely handicapped adults will depend to a great extent on the rate and manner in which these skills are performed on the job. The task of production supervision, therefore, is to change rates of work and work-related behaviors in the production setting, so that normal productivity and acceptable work behaviors result.

Individual work rates are of central importance in sheltered vocational programs. By law they provide the basis for all remuneration. They are used by the Department of Labor and several other service agencies to classify both individuals and programs (*Federal Register*, 1974). Work rates also affect the overhead income of vocational programs and thus are an important aspect of the economic feasibility and subsidy needs of these programs. Further, some data are available indicating that work rates may affect supervisors' global performance ratings, on the basis of which employment decisions can be presumed to be made (Chaffin, 1969).

Work-related behaviors in production settings have occasioned considerable comment and study. Such behaviors as attending to tasks, disruption of co-workers, self initiation, social interactions with co-workers, persistence and quality of work are clearly important in successful long-term employment.

That rates of work and work-related behaviors vary widely in sheltered vocational programs is evidenced by the voluminous attempts to account for this variability, as noted by Cobb (1969), Gold (1973), and Wolfensberger

(1967). As indicated by Bellamy (Note 3) much of the literature attempts to relate productivity to three sets of variables and their interactions: characteristics of individual workers; characteristics of the work tasks performed; and characteristics of the physical and social setting. In keeping with the practical focus of the present chapter, research will be reviewed which describes the behavior of severely and profoundly retarded adults and presents specific supervision techniques which may be useful in changing production rates.

With few exceptions research on productivity has been limited to studies of workshop clients, who are primarily mildly or moderately handicapped. Thus, the lack of studies which focus specifically on the severely handicapped simply reflects their relative absence in workshop programs. The research which is available has dealt primarily with the effects of contingent consequences on rates of work or task attending behaviors. Three of the six adults participating in the Loos and Tizard (1955) boxfolding task would now be labeled severely retarded. In that study, performance during six and one-half hour work days was observed under various supervisory conditions. During the first five weeks of observation production rate was considerably higher in each of two weekly 50 minute "supervised" periods than at other times. During these periods workers were encouraged to work as fast as possible and discouraged from engaging in non-work behaviors. Loos and Tizard (1955) then provided graphical representation of productivity by filling in squares on a histogram as soon as a worker completed 150 boxes, thereby allowing comparison of performance with previous days. Introduction of the graphs was followed by an immediate increase in production of over 200%, but this gradually declined to baseline levels during the five weeks in which the contingency was in effect. Loos and Tizard (1955) and Clarke and Hermelin (1955) note that this group subsequently was able to perform work reliably and consistently and that individual work rates could be significantly changed by altering the method of supervision. Although some aspects of the total supervision system employed by Loos and Tizard (1955) are unclear, their work provided a convincing demonstration that sustained work performance was within the capabilities of the severely retarded adults in their sample. Further, they demonstrated that production rate can be expected to vary considerably within work days and over more extended periods. Some rate variation can be reasonably attributed to the supervision procedures used, although much remains unexplained.

Crosson (1967) compared the work rates of 22 institutionalized severely and profoundly retarded adults under two different reinforcement conditions. Subjects worked under both an unspecified social reinforcement contingency intended to simulate a normal workshop setting and a specifically programmed fixed ratio contingency with token reinforcement. Work was performed during ten 24-minute periods under each contingency. Results indicated (a) statistically reliable differences between the token and social reinforcement conditions for each task and (b) an accelerating response rate across all tasks and both contingencies, which was interpreted by the author as a practice effect. It is unclear from the report whether performance differences should be attributed to type of reinforcement (social vs. tokens) or type of contingency (planned fixed ratio vs. unsystematic) and whether these differences can be expected to maintain over extended work periods. Nevertheless, Crosson's (1967) work demonstrated the effects of supervision procedures on initial work rates, and anticipated many of the issues still of concern a decade later.

Teasdale and Joynt (1967) reported the use of a token reinforcement procedure for supervision production efforts of five Down's Syndrome adolescents, some of whom were apparently severely retarded. Each performed a simple task, involving threading string through a packaging label, on which they had had considerable previous experience. Work was performed under two token reinforcement conditions. The first was a "cooperation" condition, or group contingency, in which the total performance of the group determined the reinforcement. The second was a "competition" condition. Both resulted in performance levels above undefined "normal" working conditions, although the design allows for several possible interpretations of this rate change.

Two studies by Zimmerman and his co-workers (Zimmerman, Stuckey, Garlick, & Miller, 1969; Zimmerman, Overpeck, Eisenberg, & Garlick, 1969) further evaluated the use of specifically planned contingencies of reinforcement in supervising production. Multihandicapped workshop clients performed either a terminal board assembly task or folded Goodwill bags. Contingencies which resulted in replicable improvements in work rates included (a) giving points, which could be exchanged for privileges at the end of each day when production met defined goals, (b) assignment to an isolated work area when daily work rates fell below defined goals, and (c) choice of work assignment contingent on reaching defined daily production goals.

Screven, Straka and LaFond (1971) reported the use of an automated device to change work behaviors of severely retarded adults. The work task involved assembling a two-piece coin tube. The device provided a stimulus cue (light) when assembly behaviors were appropriate and dispensed token reinforcers on predetermined schedules for task completion. Intervention strategies included changes in schedule of reinforcement for task completion behaviors and use of the light as a time out device which followed inappropriate behaviors. The authors do not present specific results, but report that, with this automatic supervision system, severely retarded adults were able to work at rates comparable to that of less handicapped clients with considerable stability of performance.

Two of the workers included in the Trybus and Lacks (1972) investigation apparently were functioning within the range of severe retardation. Work involved simple packaging and assembly tasks. For one worker an undefined contingency of token reinforcement for increases in production rates resulted in higher production rates than did either a baseline or a differential reinforcement of other behavior (DRO) condition. The worker reached a maximum of about 50 percent normal productivity during the token condition. The other worker exhibited several behaviors in the work setting which were construed as work-interfering behaviors (out of chair, turning around in chair, extended talk, refusing to use some parts). Each of these behaviors was reduced to near-zero frequency when supervisor attention was withheld following their emission.

Karen, Eisner and Endres (1974) used a token reinforcement system with adults labeled severely retarded. Each worker was involved in some aspect of preparing tin cans as nursery specimen cans. Work was performed during three hour and fifteen minute work days, but data were obtained during only 12 minutes of observation each day. Tokens were given on what was described as a variable interval schedule for appropriate work behaviors. Observation data indicated an increase in attending to task with the token reinforcement as compared to baseline conditions in a reversal design, and some decrease in errors during treatment. Overall productivity appeared little affected, however, and a two- or three-fold increase in production during followup suggests that all subjects may have been working somewhat inefficiently throughout the study. Nevertheless, the results do support the utility of supervisor controlled contingencies in changing rates of the work related behaviors of task attending and performance accuracy.

The use of social contingencies to increase work rates was the focus of a study reported by Bellamy, Peterson and Close (1975). A severely retarded man assembled a 52-piece cam switch actuator under baseline conditions which were not defined and under treatment conditions in which supervisors were instructed to provide either social praise or prompts to return to work every two minutes. The effectiveness of the increased supervisor contact was demonstrated in a reversal design, with production rates during treatment frequently above the normal time standard for the product.

In two additional case studies with adults labeled severely retarded, Bateman (1975) successfully increased the amount of time spent on specific work activities. In each case, when the opportunity to work on a more preferred task was made contingent on prior performance of a less preferred task, time spent on the less preferred task increased. In spite of the extremely short time frame of the study (two days in each experimental condition), the results demonstrated the possible use of the Premack principle in vocational supervision.

Two studies reported by Martin and Flexer (Note 1) provide further evidence that on-task behaviors of workers can be increased by varying supervision procedures. In both studies, workers were asked to work for gradually increasing periods of time, with reinforcement contingent on maintaining work-behaviors throughout the period. On-task behaviors, productivity, and independence from supervisor prompts were increased.

The production studies discussed above strongly suggest that productivity levels of severely and profoundly retarded adults must be attributed at least in part to the type of supervision they receive. Unfortunately, many variables in the supervision process simply have not been explored with this population. Therefore, the information needed to define effective comprehensive supervision procedures is not available. However, research with less severely handicapped workers does offer some additional suggestions. For example, as Bellamy (Note 3) noted, the work rates of retarded individuals have been related to a variety of procedures including: (a) providing definitive instructions which encourage competition (Gordon, O'Connor and Tizard, 1955; Huddle, 1967) or set performance goals (Gordon, O'Connor and Tizard, 1954; Kliebhahn, 1967; Zimmerman, Overpeck, Eisenberg, & Garlick, 1969); (b) providing contingent positive reinforcement for work behaviors, using such consequences as money (Brown, Van Deventer, Perlmutter, Jones, & Sontag, 1972; Huddle, 1967; Schroeder, 1972), music (Bellamy & Sontag, 1973; Cotter, 1971; Podvin, 1967), edibles (Brown, Johnson, Gadberry & Fenrick, 1971) and knowledge of results (Jens & Shores, 1969; Levy, 1974); (c) changing the contingency relationship between the work performance and reinforcing event (Schroeder, 1972; Trybus & Lacks, 1972); (d) providing contingent punishing consequences for low work rates (Greene & Hoats, 1969; Screven & LaFond, 1973; Zimmerman, Overpeck, Eisenberg & Garlick, 1969); (e) arranging for work with a more competent co-worker (Abel, 1938; Brown & Pearce, 1970; Kliebhahn, 1967). Thus there are a variety of potential changes in the work environment which may improve production rates. Until more applied research is completed with severely and profoundly retarded workers, these studies with the more mildly handicapped may provide some assistance in the design of useful supervision techniques.

Some Practical Implications

In evaluating the applicability of production research with both mildly and severely retarded populations, the practitioner must ask whether there are systematic differences between the reported experimental situations and the applied vocational settings in which the results may be utilized. Three questions seem particularly relevant: (a) Are the results generalizable to the larger population of severely and profoundly retarded adults who may be included in vocational programs? (b) Can the relationships between various supervision procedures and productivity be expected to maintain over the extended time periods which are inherent in practical vocational programs? and (c) Are the experimental treatments feasible in practical vocational programs?

Applicability to the severely and profoundly retarded population. With the exception of Crosson's (1967) work, most production studies involved subjects who were either enrolled in vocational programs or specifically selected for those programs. It is difficult to evaluate whether this selectivity has systematically eliminated some severely handicapped individuals whom future vocational programs will be expected to serve. The applicability of findings across individuals will thus be clearer if future production research efforts systematically include groups who may have been denied entrance to vocational programs.

A specific issue in applicability across individuals is the possibility that many stimulus events which the production supervisor can control might have less influence on the behavior of more severely handicapped workers. It is quite possible that the range of effective reinforcing events is reduced for some severely and profoundly retarded individuals. See, for example, the many efforts to identify effective reinforcing events for this groups (Hollis, 1964; Tramontana, 1972; Watson, Orser, & Sanders, 1967). It also seems likely that many discriminative stimuli, especially verbal communications, may be less useful with many severely handicapped individuals. Similarly, the utility of many contingency arrangements may be reduced by the initial inability of a worker to count, tell time, or otherwise monitor progress in relation to contingency requirements. These possibilities underscore the need to monitor individual performance under any supervision procedure, regardless of its previous effectiveness with other workers.

Applicability to long term vocational involvement. Most of the available research has evaluated the relationship between supervision procedures and work performance during relatively brief time periods. Whether performance during the first few weeks after a procedure is implemented is representative of performance during several months or years in a vocational program is a valid question. Changes in work rates over time were found in several studies. In many of these, gradual improvement over time appears to reflect the effects of practice or exposure (Claridge & O'Connor, 1957; Crosson, 1967; Gold, 1973b; Gordon, 1962; Kahn & Burdett, 1967). In other studies, evidence is available that the effectiveness of contingency arrangements may decrease considerably over time (Loos & Tizard, 1955).

Applicability to actual workshop settings. The third possible impediment to research utilization reflects the practical realities of staff ratios, staff expertise, and equipment budgets in existing community programs. Research is needed to develop measurement systems and supervision procedures which can be implemented in typical workshop settings, and to develop and evaluate methods of staff training which will assist this implementation. The task of the practitioner charged with production supervision is to maximize the productivity and accuracy of each worker. Typically, this must be done in situations which are not maximally favorable research settings. For example, staff-worker ratios may be poor; supervision staff may not have access to necessary consultants; data processing and data display services may be totally absent; and type of work may vary considerably over time and across workers.

Some Specific Tehniques

While the research on changing work rates clearly demonstrates the potential importance of supervision techniques, it does not provide a practical guide for combining these techniques into a useful overall supervision system. However, a few practical suggestions can be made which do appear consistent with the available research. Each will require some additional expenditure of staff time, but to the extent that they result in higher production levels for individual workers, they should result in more efficient operation of a total vocational program.

1. Distinguish between vocational training and production supervision functions and include a worker in the production supervision setting only after the topography of the work behavior has been established and brought under stimulus control of task cues. The individual attention which is necessary to correct problems in topography or stimulus control during training can often function as a powerful social reinforcer for error responses in a production setting where one-to-one attention is not usually available.
2. Implement daily measurement systems for worker productivity, based on number of work units completed, on-task behavior, or both. Work units completed during given time intervals are frequently recorded for payroll information, and daily totals or averages could be made available to production supervision staff with little extra effort. On-task behavior may be monitored on jobs not easily divided into equivalent units by time sampling procedures. For example, whether each of a group of workers is on- or off-task at the end of 5-minute intervals can be recorded in a few seconds by a supervisor with a simple timing device which signals when to observe and record.
3. Identify events in the work environment which may function as reinforcing events for various workers, e.g., staff attention and assistance, access to various staff members for professional contact, assignment to preferred jobs, pay check advances, and so on.
4. Plan systematic contingencies of reinforcement, using the events identified as consequences for task completion or task attending behaviors. Implementing these contingencies would be the primary role of the immediate floor supervisor.
5. Evaluate the effectiveness of each contingency arrangement by noting its long term effects on the daily measures of productivity or attending behaviors of workers.

Summary and Recommendations

Research on habilitation of the severely and profoundly retarded provides an ample basis for viewing these individuals as potentially vocationally competent persons. Techniques are being developed which effectively remediate at least two kinds of problems which produce vocational incompetence: lack of the requisite skills, and performance of existing skills at inappropriate rates. For skill deficiencies, the literature suggests several approaches for both shaping desired response topographies and establishing necessary stimulus control. For problems of inappropriate rates, production supervision research with both severely and moderately handicapped individuals has illustrated several techniques which might be combined effectively by the practitioner who pragmatically evaluates their effect on individual productivity. In light of these results, policies and programs which presume that limited vocational potential necessarily accompanies severe handicaps should be critically reviewed. Nonetheless, many questions remain about specific procedural issues in both training and supervision. Procedures should be refined for teaching generalized skills or "operations" which are functional in a variety of vocational situations. More efficient procedures are needed for teaching the complex operant chains which available work often requires. Applied research on supervision procedures is needed to identify combinations of procedures which are feasible in normal work settings, which allow for differences among individuals in specific procedures used, and which effectively maintain high work rates over long periods of time.

To view the vocational difficulties of severely handicapped adults as skill deficits rather than deficits in individual potential has several implications. For the community programs which may now begin to serve these adults, this view should affect both the objectives of the programs and the persons who are selected for participation. Vocational participation and remuneration is an objective which is both feasible in community programs and consistent with professional values of normalization and individual development (Roos, 1975). It should thus be one of the criteria on which quality of these programs is evaluated. Further, severely handicapped adults should be selected for inclusion in more vocational programs. In the past, the feasibility criterion imposed by vocational rehabilitation agencies has prevented the severely handicapped from taking advantage of many vocational services. Functionally, this feasibility criterion has been the adult counterpart of the exclusion clause which kept many severely handicapped children out of the public schools before court intervention. However, the vocational training and supervision research reviewed here suggests that lack of feasibility must be attributed more to availability and quality of vocational programs than to an inherent limit on individual potential. Gold's (1973) concern with the misuse of assessment procedures is still timely. Scores obtained from standardized tests and certain work sample procedures appear to bear little practical relationship to actual performance following training. Yet, there are considerable individual differences in response to vocational training and supervision procedures. It is clear from the research that training will be much more difficult, expensive and time consuming for some severely handicapped individuals than for others. If assessment instruments could be devised which reliably predicted the time or cost of the needed training and supervision, selection and placement decisions might be made on a more empirical basis without presupposing limits on individual productivity. A preliminary description of such an assessment effort is reported by Bellamy and Snyder (1976).

To view severely and profoundly retarded adults as potentially vocationally competent individuals has many implications for the roles of education, industry, and government. The feasibility of long term vocational goals places considerable responsibility on special education programs. Along with economic involvement, severely handicapped individuals may be able to participate competently in many aspects of community life, if they have the necessary skills. Therefore, educational programs for the severely handicapped must focus on longitudinal objectives, develop sequenced instructional goals which lead toward those objectives, and insure that the skills taught are, in fact, utilized in students' natural environments (Brown, Nietupski, & Hamre-Nietupski, 1976; Williams, Brown, & Certo, 1975).

A response from government and industry to the vocational competence of the severely and profoundly retarded is also needed. As vocational opportunities become available to this group, they should be included in national manpower planning and considered for a variety of work possibilities that are now subcontracted outside this country. Despite tacit acceptance of the phrase "Hire the handicapped," those who are severely involved are rarely even considered as potential employees. The research and program results reviewed here suggest that this is an unecessary exclusion.

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A Conceptual Analysis of Vocational Training With the Severely Retarded

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A Conceptual Analysis of Vocational Training With the Severely Retarded

Teaching or training involves the manipulation of antecedent and consequent events to alter the probability that a particular response will follow a particular stimulus. This applies to teaching a child to produce a certain sound when presented with a letter, to teaching a college student the step-by-step process necessary for solving a calculus problem, or to teaching a severely retarded adult to complete a small parts assembly task. The child is to respond in the presence of a letter, the college student when given a calculus problem, and the retarded adult when presented with the unassembled parts of a task. If prior to instruction the learner did not perform correctly when presented with relevant stimuli, and if after instruction s/he consistently does respond correctly, we infer that learning took place (Ellis, 1972).

The goal of most teaching, however, is not just to teach specific responses to specific stimuli, but to teach skills that extend beyond the examples and setting used in instruction. Becker and Engelmann (1977) refer to this goal as teaching a *general case*. "A general case has been taught when, after instruction on some tasks in a particular class, any task in that class can be performed correctly" (p. 1). The child produces appropriate sounds when presented with letters that are bigger, different in color, or in a different typeface, from those seen in training. The college student uses the skills acquired during training to solve calculus problems s/he has never encountered before. The retarded adult uses skills (e.g., use of a screwdriver) acquired during training on one task to correctly assemble parts of other tasks. In each case skills acquired in the presence of one stimulus context are performed in new or different contexts.

The value of teaching the general case to individuals learning to read or solve academic problems has been apparent to educators (Engelmann, 1969). The importance of teaching the general case in vocational training with the severely retarded, however, has not. The ability of the severely retarded to learn specific vocational skills is well documented (Bellamy, Peterson, & Close, 1975; Gold, 1972, 1976; Hunter & Bellamy, 1976; Jacobs, 1976; Martin & Flexer, Note 1), yet the adaptability of these responses remains unassessed. The purpose of the present chapter is to explore the relevance of teaching the general case as described by Becker, Engelmann and their associates (Becker & Engelmann, 1977; Becker, Engelmann, & Thomas, 1975; Engelmann & Bruner, 1969; Engelmann & Carnine, 1969; Engelmann & Osborn, 1970) for vocational training with the severely and profoundly retarded. The chapter will describe a model of vocational training and discuss the utility of the programming approach of Becker and Engelmann in light of this model.

A Vocational Training Model

Completion of most vocational tasks available to workshops involves repeated performance of a specific sequence of responses, or an *operant chain*. Each response in the chain must follow certain task-relevant stimuli and must be performed to an acceptable criterion. Training a severely retarded worker to complete the task involves teaching the precise topography of each response required by the task, and bringing these under control of relevant stimuli.

Response Topography

The topography of a response describes the specific movements or manipulations the worker must perform. Response topographies required by vocational tasks frequently involve grasping an object between the thumb and index finger, holding a tool with fingers and palm, rotating the hand, applying pressure with fingers, and flexing and relaxing biceps and triceps to lift and reach. The way in which these motor responses are combined defines the response being learned. For example, the response, tightening a screw with a screwdriver, is a function of many changes in muscle tension. While the normal worker might be taught all of the aspects of this response simultaneously, a severely retarded worker may require instruction in the specific topography of each reaching, grasping, turning and releasing aspect of the response. Training is incomplete if a worker has not learned to perform all required response topographies.

For some workers, a physical handicap or lack of dexterity may result in a particular response topography being extremely difficult or impossible to perform. For these workers at least two options exist. One involves the use of prosthetic task manipulation (i.e., fixtures or jigs); the other is extensive training in muscle control. Fixtures can be used to simply change the response demands of a task. Figure 1 shows a fixture contructed at the Specialized Training Program, a subcontract workshop for severely and profoundly retarded adults at the University of Oregon. This fixture allows a worker to use both hands to manipulate a screwdriver, rather than using one hand to hold the assembly and the other to operate the screwdriver. By changing the response demands of the task, the fixture allows this worker to perform the task with response topographies that appeared easier for him.

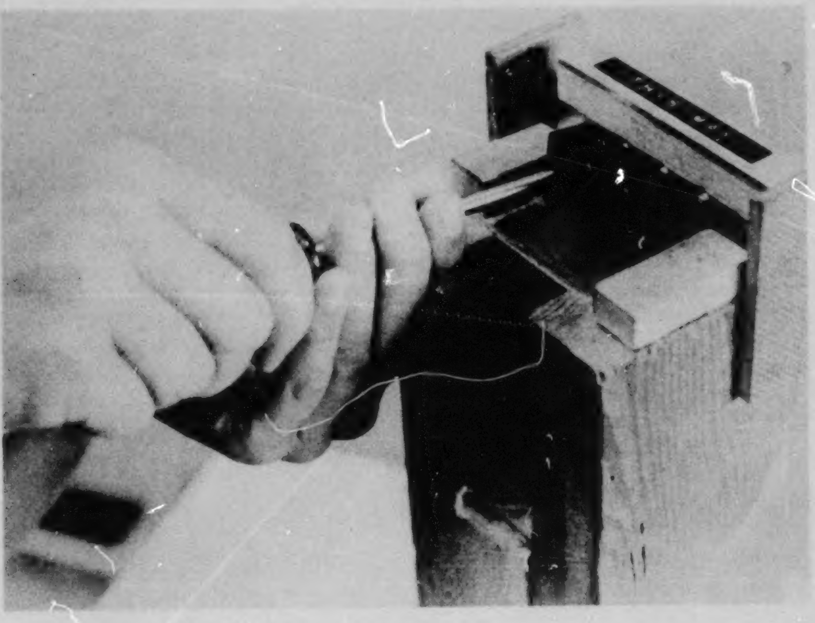


FIGURE 1

Fixture used to assist adapter assembly by a severely retarded adult.

The second option involves direct training of required movements. Recent research on biofeedback (Inman, in press) may be relevant to difficult training problems. This research suggests improved muscle control may be trained by manipulating the feedback a worker receives about the tension of his or her muscles. Further research in this area is currently needed to develop more practical vocational applications.

Stimulus Control

To complete a task accurately a worker must not only perform the responses required by the task, but perform those responses in a specific sequence. For appropriate sequencing to occur the responses must each be under control of task-relevant stimuli. To the extent that this stimulus control exists, there will be a high likelihood that each set of task-relevant stimuli will be followed by the appropriate response.

Stimulus control describes the extent to which an antecedent stimulus functionally alters the probability of a conditioned response (Terrace, 1966). Two criteria have been identified as sufficient for development of stimulus control: (a) the learner's attention to relevant stimuli within the task, and (b) differential reinforcement for correct responding (Skinner, 1969; Terrace, 1966). This suggests that stimuli of a work task will come to control task-relevant responses (a) if those stimuli are attended to by the worker, and (b) if they set the occasion for reinforcing consequences when appropriate responding occurs. The worker should be able to discriminate the relevant stimuli, and the trainer or teacher should deliver reinforcers only when appropriate responses are emitted.

An application of these stimulus control principles can be seen in the cam switch actuator pictured in Figure 2. The actuator is an oscilloscope part

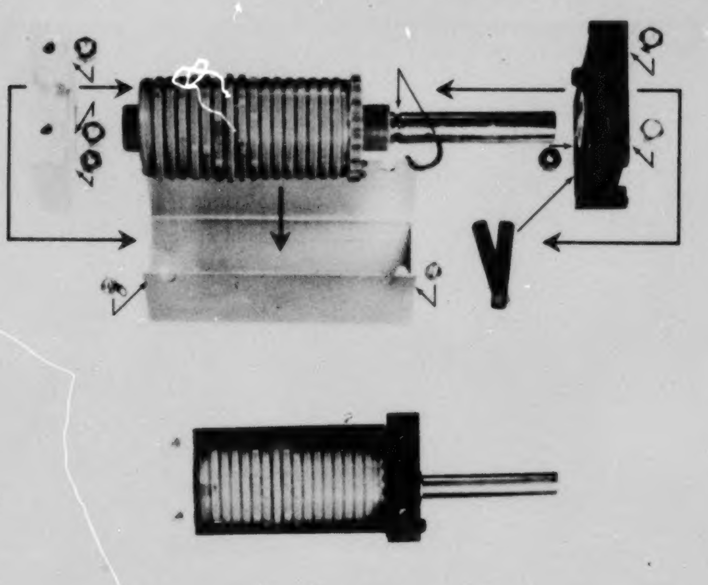


FIGURE 2

Exploded and assembled views of a cam switch actuator.

assembled by workers in the Specialized Training Program. The 77 steps required to assemble the cam are provided in Table 1. Steps 68 through 73 of this task involve placing a .15 x 2.22 cm sheet metal screw in the only re-

TABLE 1

Task Analysis for Cam Switch Actuator

S^D		Response
1) Seventeen bins filled with task parts, tools	-	Move marker to bin one
2) Marker in front of bin one	-	Pick up ohe black bearing
3) Bearing in hand	-	Place on table with flange facing up and knob away
4) Bearing on table, flange up, knob away	-	Move marker
5) Marker in front of bin two	-	Place two large nuts on spots in front of marker
6) Nuts on spots	-	Pick up needle-nose pliers
7) Pliers in hand	-	Put one large nut in tip of pliers
8) Nut in pliers	-	Seat nut in open slot of bearing
9) Nut seated	-	Put other large nut in tip of pliers
10) Nut in pliers	-	Seat nut in remaining open slot of bearing
11) Nut seated	-	Rotate bearing so flange faces down
12) Flange down	-	Move marker to bin three
13) Marker in front of bin three	-	Pick up one small nut in tip of pliers
14) Nut in pliers	-	Seat nut in open slot of bearing
15) Nut seated	-	Put pliers on table
16) Pliers on table	-	Place bearing in jig, knob in right hole, flange facing left
17) Bearing in jig	-	Move marker to bin four
18) Marker in front of bin four	-	Pick up barrel
19) Barrel in hand	-	Place tongue of barrel into bearing, red notch visible through roller hole
20) Barrel in bearing	-	Move marker to bin five
21) Marker in front of bin five	-	Pick up retaining ring and place on apron, points facing away
22) Ring on apron	-	Pick up ring tool with writing facing up
23) Tool in hand	-	Slide tool over ring until ring holds
24) Ring in tool	-	Seat ring onto groove in barrel tongue
25) Ring seated	-	Put ring tool on table
26) Ring tool on table	-	Pick up pliers
27) Pliers in hand	-	Move marker to bin six
28) Marker in front of bin six	-	Use pliers to pick up one roller
29) Roller in pliers	-	Place roller in roller hole
30) Roller seated	-	Move marker to bin seven
31) Marker in front of bin seven	-	Pick up spring and place in pliers with black mark up
32) Spring in pliers	-	Rotate jig so barrel tongue faces away
33) Tongue facing away	-	Place spring in bearing
34) Spring seated	-	Move marker to bin eight
35) Marker in front of bin eight	-	Pick up spring and place pliers with black mark up
36) Spring in pliers	-	Place spring in bearing on top of previous spring
37) Spring seated	-	Move marker to bin nine
38) Marker in front of bin nine	-	Pick up white bearing and place on table with knob away, holes facing up
39) Bearing on table	-	Move marker to bin ten
40) Marker in front of bin ten	-	Place two large nuts on spots in front of marker
41) Nuts on spots	-	Pick up pliers
42) Pliers in hand	-	Put one large nut in tip of pliers
43) Nut in pliers	-	Seat nut in one of the upper open slots in bearing
44) Nut seated	-	Put other large nut in tip of pliers
45) Nut in pliers	-	Seat nut in remaining upper bearing lsot
46) Nut seated	-	Move marker to bin eleven
47) Marker in front of bin eleven	-	Put one small nut in tip of pliers
48) Nut in pliers	-	Seat nut in bottom bearing slot
49) Nut seated	-	Put pliers down
50) Pliers on table	-	Place bearing in jig, knob down, nuts facing in, barrel in bearing hole
51) Bearing in jig	-	Move marker to bin 12
52) Marker in front of bin twelve	-	Pick up one case
53) Case in hand	-	Place case over bearings and barrel open end down, case lips in bearing slots
54) Case seated	-	Move marker to bin thirteen
55) Marker in front of bin thirteen	-	Pick up one lip washer
56) Lip washer in hand	-	Place lip washer over casing hole above white bearing, lip up

TABLE 1 (Continued)

57) Lip washer over casing hole	-	Move marker to bin fourteen
58) Marker in front of bin fourteen	-	Pick up one screw
59) Screw in hand	-	Place screw threads in casing hole above white bearing
60) Screw in hole	-	Pick up torque screwdriver
61) Screwdriver in hand	-	Place nose of screwdriver in head of screw
62) Screwdriver in screw	-	Press down and rotate screwdriver in a clockwise direction until screw is tight (indicating three pounds of pressure)
63) Screw is tight	-	Place screwdriver on table
64) Screwdriver on table	-	Move marker to bin fifteen
65) Marker in front of bin fifteen	-	Pick up one flat washer
66) Washer in hand	-	Place washer over casing hole above blade bearing
67) Washer over casing hole	-	Move marker to bin sixteen
68) Marker in front of bin sixteen	-	Pick up one screw
69) Screw in hand	-	Put the threaded end of the screw in the hole
70) Screw in hole	-	Pick up screwdriver by the handle
71) Screwdriver in hand	-	Put the point of the screwdriver in head of screw
72) Screwdriver in screw	-	Rotate screwdriver in a clockwise direction until screw is tight
73) Screw is tight	-	Put the screwdriver down
74) Screwdriver on table	-	Move marker to bin seventeen
75) Marker in front of bin seventeen	-	Pick up one plastic bag with open end facing up
76) Bag in hand	-	Place completed cam in bag
77) Cam in bag	-	Place cam and bag in box and raise hand

maining hole on the cam housing, and screwing it tight. This part of the task can be viewed as a response chain with six links or discriminated operants: (a) pick up a screw, (b) put the threaded end of the screw in the hole, (c) pick up the screwdriver by the handle, (d) put the point of the screwdriver in the head of the screw, (e) rotate the screwdriver in a clockwise direction until the screw is tight, and (f) put the screwdriver down. Each of these responses is cued by a task-relevant discriminative stimulus (S^D). The stimuli produced by performing the first response act as the S^D for performing the second response. This pattern continues with the second response producing the S^D for the third, and so forth until the task is complete. The greater the probability of each response when its S^D is presented, the greater the degree of stimulus control that exists. Each response is defined by a particular topography and a criterion. The topography indicates how the response is to be performed. The criterion operationally defines the effect the response has on the environment (e.g., the criterion for rotating the screwdriver is met when the screw is tight). The task is learned when each of the six S^Ds in the chain is very likely to be followed by the appropriate response.

Figure 3 illustrates the chain of stimulus-response relationships that occur as this small task is performed. The empty hole in the cam housing and the loose screw serve as the discriminative stimuli (S^D_1), which set the occasion for picking up the screw (R_1). The criterion for this response is met when the worker is holding the screw in his or her hand. The stimuli provided by seeing and feeling the screw in hand also function, however, as the discriminative stimuli (S^D_2) for putting the screw in the hole (R_2). The criterion for this response is met when the threaded end of the screw is in the hole. The screw in the hole functions as the discriminative stimulus (S^D_3) for the next response (R_3), picking up the screwdriver. Performance of this response produces stimuli (S^D_4) which cue the next response (R_4) and so on, until the worker completes the task and lays down the screwdriver. At this point the chain ends, and a reinforcer (S^{R+}) in the form of food, praise, tokens or wages, typically is delivered. The reinforcer, delivered at the end of the chain, serves to maintain control of each response in the chain (Kelleher, 1966). As the chain develops, additional reinforcement is provided by the fact that each S^D within the chain comes to function as a reinforcing consequence for the previous response (e.g., S^D_2 serves as a conditioned reinforcer for R_1 and S^D_3 serves to reinforce R_2, etc.). To achieve this situation the chain must terminate with a reinforcer (S^{R+}) as indicated below.

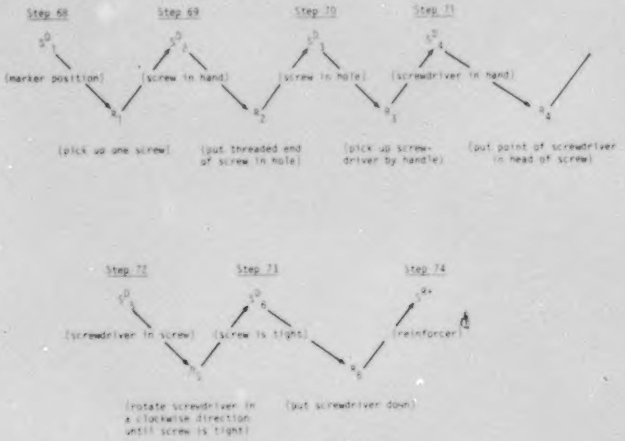


FIGURE 3

Operant chain defined by steps 68-73 of task analysis for cam switch actuator.

Within this model, (a) each response is cued by a different S^D; (b) each response has a criterion which defines the next S^D; (c) each S^D serves both to reinforce the previous response, and to set the occasion for the next response; and (d) maintenance of the entire chain is dependent upon the terminal reinforcer.

Development of an operant chain is typically accomplished through a systematic application of shaping, fading and differential reinforcement procedures. Successive approximations of desired responses are differentially reinforced, and trainer assistance in the form of physical priming, modeling and verbal cues is gradually decreased (Bellamy, Inman, & Schwarz, in press; Screven, Straka, & LaFond, 1971).

Utility of the model

Vocational training procedures based on this or similar models have been used to teach an impressive array of tasks to severely retarded workers(Bellamy, Peterson, & Close, 1975; Crosson, 1967; Gold, 1976; Martin & Flexer, Note 1). However, retarded workers must not only learn vocational skills, but often must learn those skills quickly. The time necessary for training a worker is especially important when industrial demands (e.g., short-lived contracts) require that several successive tasks be learned over a short time period. The cam switches shown in Figure 4 are a sample of the variety of cams assembled at the Specialized Training Program workshop. Though similar in many respects, each requires some unique responses. It is not uncommon for the contractor to require that a new cam be learned, and a substantial quantity assembled within a four day period. A significant factor in a retarded worker's ability to respond to demands such as these will be the degree to which skills learned on one task transfer to other tasks with similar response requirements.

The question this raises is how learning within one stimulus context affects

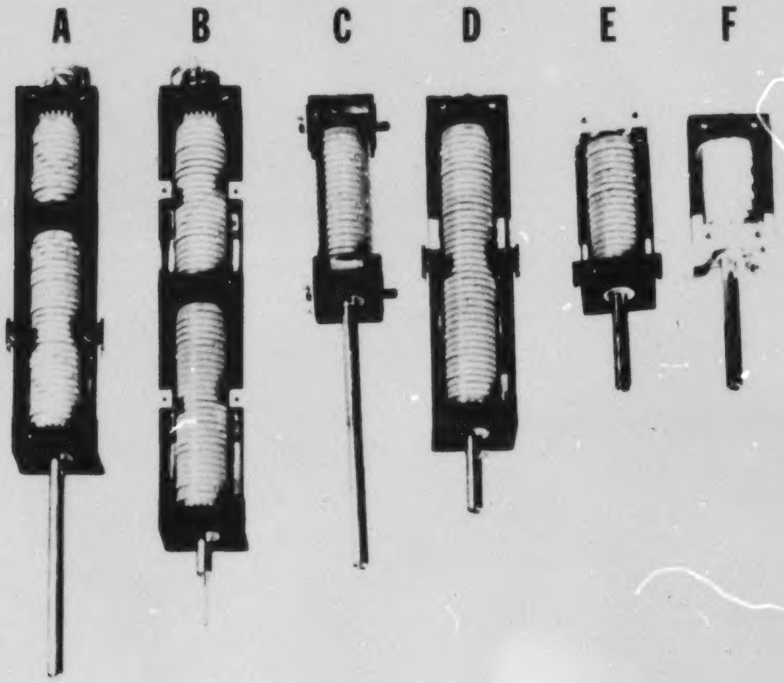


FIGURE 4

Six different cam switches assembled at the Specialized Training Program.

later performance in another. This is not an issue unique to training the severely retarded. It has been addressed in a variety of reports on transfer of training (Gray & Fygetakis, 1968; House & Zeaman, 1960), development of learning sets (Harlow, 1949; Sahakian, 1970), and stimulus generalization (Lovaas, Koegel, Simmons, & Long, 1973; Terrace, 1966). This research has generally emphasized the effects of similarity between stimuli in the training and transfer tasks. If two tasks require similar responses (e.g., threading nuts on bolts), and the stimuli cuing these responses are similar (e.g., unassembled nuts and bolts), then training on the first task will generally facilitate acquisition of the second. This research emphasizes the effects of task variables. It suggests a worker should be assigned successive tasks which have common stimulus characteristics serving as discriminative stimuli for common responses, if the time required to train later tasks is of concern. This could involve, for example, assigning a series of circuit boards to a worker (Merwin, 1974). Many circuit board tasks provide similar polarity, position or match-to-sample cues for similar component insertion responses.

An alternative analysis of the effects that learning one task has on acquisition of other tasks emphasizes the effects training procedures have on facilitating positive transfer. This approach is the focus of the present chapter. It builds from an operant model of response acquisition, and the educational movement toward direct instruction (Becker, Engelmann, & Thomas, 1975; Carnine & Bateman, 1977).

Becker and Engelmann (1977) maintain that performance on novel tasks is functionally related to two variables: (a) the similarities between the new task and previously learned tasks, and (b) the extent to which the general case was taught in previous training. A general case can be taught with respect to classes of stimuli or classes of responses. When a general case is taught with respect to a class of stimuli a *concept* has been taught. When a general case has been taught with respect to a class of responses an *operation* has been taught (Becker, 1971; Becker & Engelmann, 1977; Becker, Engelmann, & Thomas, 1975). If vocational training with the severely and profoundly retarded is to provide viable work skills trainers will need to identify and teach the concepts and operations required by the tasks which an individual is likely to encounter.

Concepts

Within any universe of stimulus instances unique classes of stimuli can be identified. The members of a particular class of stimuli are identified by the common stimulus characteristics they possess. Members of the stimulus class "crescent wrenches" may vary across characteristics such as texture, size, position in space, smell and many more, but they will all be objects with a crescent wrench shape (see Figure 5). If an individual were taught to perform a particular response (e.g., pick up, adjust, or any other response) when presented with a crescent wrench, and after training with some crescent wrenches responded in the same way to all members of the class, "crescent wrenches", we could say s/he had learned the general case, or the concept.

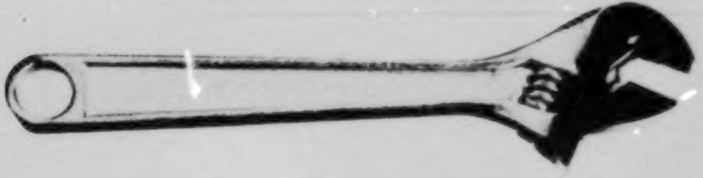


FIGURE 5

A crescent wrench.

The concept is defined by the stimulus characteristics uniquely common to members of that class. Each stimulus possessing the relevant set of characteristics is an *instance* of that concept. Any stimulus not possessing all the relevant characteristics is a *non-instance* of that concept.

The stimulus characteristics which uniquely define the concept "crescent wrench" from that of other common hand tools include (a) a handle, (b) a curved, flat head at the top of the handle, (c) the potential for adjusting an opening in the foremost point of the head to fit nuts of several sizes, and (d) hard metal construction. Any object which provides all of these stimulus characteristics is an instance of the concept, "crescent wrench". Any object which provides none or only some of these stimulus characteristics is not an instance of the concept. When a worker who has learned a response to one crescent wrench performs that response in the presence of any crescent wrench regardless of the wrench's size, color or texture, s/he has learned the concept, "crescent wrench".

Defining a concept based on stimulus characteristics unique to instances of that concept allows differentiation between instances and non-instances of the concept within any universe of objects or stimuli. The degree of specificity with which the stimulus characteristics need to be labeled, however, will be dictated by the similarity between instances and non-instances in the stimulus universe. If non-instances are considerably different than instances, discrimination of instances and non-instances can be made on the basis of only a few relevant stimulus characteristics. Instances of the concept, "crescent wrench" can be discriminated easily from a universe of crescent wrenches, coats, axe handles, pencils, and glue, because there are several obvious stimulus differences between crescent wrenches and all other members of this universe. To identify crescent wrenches in this universe, a learner would need to attend to either the metal construction, or the shape, or the adjustability of the objects. However, if the universe consisted of crescent wrenches, pliers, pipe wrenches and socket wrenches, the stimulus characteristics necessary to define an instance of "crescent wrench" would require more detailed specification; only the shape of the various objects would provide a reliable means of identifying members of the concept "crescent wrench". The degree to which non-instances of the concept are similar to instances dictates the precision with which the concept must be defined.

A second characteristic of concept analysis is that identification of an instance requires a double discrimination process. When presented with all members of a stimulus universe and asked to specify which are instances of a particular concept the learner must (a) discriminate which stimulus characteristics are going to be relevant for identifying instances and (b) use these relevant characteristics to identify which elements of the universe meet the stimulus requirements of an instance. In the above example, identification of all instances of "crescent wrench" would require that the learner (a) attend to shape characteristics of objects in the universe while ignoring size, color, orientation and position characteristics, and (b) examine each member of the universe and respond only to those shaped like crescent wrenches.

The dual discrimination analysis of concept learning may be a valuable method of identifying relationships between a worker's error patterns and training procedures. A worker who consistently performs incorrectly may be either attending to irrelevant stimulus dimensions or simply failing to discriminate instances from non-instances along the relevant dimensions. It is possible these two potential sources of error will require different strategies for remediation.

Concept analysis expands the model of vocational tasks as response chains. In concept teaching responses are conditioned to classes of stimulus characteristics rather than specific stimuli. A response in the chain no longer follows a particular S^D but any S^D from a stimulus class (S^D_i). In a response chain where specific responses are under concept control each S^D in the model is replaced by a stimulus class.

The way in which concept learning expands the versatility of conditioned responses can be seen by examining a small part of the cam switch assembly. Figure 6 shows eight different bearings used in assembling cam switches at the Specialized Training Program. The bearings differ in shape, color, and construction material. Each bearing is made of moulded plastic or metal and at least one flat surface contains several holes. These holes vary in shape, size, location on the bearing, and depth. Three or four of these holes in each bearing form slots into which a .15 x .45 cm hex nut fits snugly. As is apparent in Figure 6, these slots vary in their position on the bearing and in their overall configuration.

One response in assembly of a cam switch is to place a hex nut in each empty slot of two or three different bearings. If this hex nut insertion response were brought under control of specific stimuli associated with a single slot in the first bearing in Figure 6, it is likely that some trainees would not per-

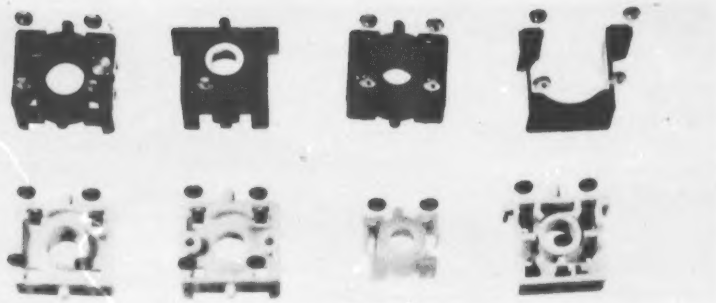


FIGURE 6

Eight bearings used in assembly of different cam switches.

form the behavior in response to stimuli provided by other slots on that bearing or by slots in other positions on different bearings. In the formulation of vocational tasks as simple response chains, the stimuli controlling the next insertion response could be very specific, as indicated below:

S^{D}_{1}

(Bearing number one with an empty hex nut slot in the upper left corner)

R_1

(Insert hex nut in slot)

If this same response were under control of a concept, any stimulus which was an instance of the concept "empty slot" would control the response. The unique stimulus characteristics defining instances of the concept are: (a) a cam bearing, and (b) an empty hex slot of the appropriate size. Bearing size, shape, color or position in the cam, and location of the slot in the bearing are all irrelevant. If the response, place a hex nut in the open hex slot, were under control of a concept, the stimuli controlling the response could vary across all irrelevant dimensions. All stimuli with the relevant characteristics would form a stimulus class (S^{D}_{1}) with any member of that class controlling placement of the hex nut.

S^{D}_{1}

(*Any* bearing with an empty hex nut slot in any position)

R_1

(Place hex nut in slot)

Teaching Concepts

Concept teaching involves the manipulation of antecedent and consequent events in an effort to change the probability that an individual will emit certain responses only in the presence of instances of a concept. To achieve this end: (a) Present a set of instances and non-instances rather than a single instance. (b) Ensure that within the set of instances and non-instances, instances share all the relevant stimulus characteristics and non-instances possess none or only some of the relevant characteristics. (c) Vary irrelevant stimulus characteristics. This will facilitate responding only to relevant characteristics. (d) When several relevant characteristics are required to define a concept, present the characteristics in a cumulative fashion starting with only one then adding a second, then a third, etc. Require the learner to meet a response criterion at each level of this cumulative progression. (e) Provide differential reinforcement for appropriate responding.

An over-simplified example of teaching a concept can be seen in a task demanding that hex nuts, regardless of size and color, be sorted from a bin of hex nuts, square nuts, bolts, washers and clamps. The concept being taught would be "hex nut". To teach the concept, "hex nut": (a) Present the worker with both hex nuts (instances) and bolts, washers, square nuts, and clamps (non-instances) during training trials. (b) Instances should all share the common characteristics of being six-sided, flat, and having a threaded hole in the middle. Non-instances should possess none or only some of these characteristics. (c) When training the worker to respond to instances of the concept "hex nut" do not use just one hex nut. Use several that are of different size and color so the worker learns that size and color are not relevant characteristics. (d) If a more complex sorting task required the worker to sort out only brass hex nuts, first teach him to sort hex nuts from non-hex nuts; next teach sorting of brass hex nuts from non-brass hex nuts, and then sorting of brass hex nuts from all the other parts. (e) Throughout the teaching process reinforce the worker only when s/he responds in the presence of hex nuts. Ignore or correct all incorrect responses.

Concept teaching is a logical extrapolation of traditional procedures for teaching discriminations. As in discrimination training, differential reinforcement is used to obtain stimulus control of specific responses. In concept training, however, those responses are not brought under the control of a specific stimulus, but under the control of a set of stimulus characteristics. The major difference between teaching concepts and traditional discrimination training is the particular manipulation of antecedent events. Concept teaching requires presentation of both a greater number and more varied set of training examples.

Teaching concepts is advantageous if the learner will need to perform newly acquired skills when presented with stimuli not experienced in the training setting. Retarded adults in vocational workshops have generally performed specific task-related responses to specific task-related stimuli. As workers are expected to perform multiple tasks, and use training received on one task to facilitate performance on other tasks, additional attention will need to be given to the programming variables affecting concept learning.

Operations

An operation is defined by the common response characteristics of a set of responses under stimulus control (Becker & Engelmann, 1977). An individual response is not an operation. Rather, it is an instance of an operation. The operation itself is defined by the common effect, or characteristics, of the response class. Just as concepts are defined by the common characteristics of stimuli, so operations are defined by the common effect, or characteristics, of the response class.

The operation "writing" might include response instances of writing letters, writing memos, writing with a pencil or writing with a pen. These responses are under stimulus control and have the common effect of producing words on a page. They are instances of the operation, "writing". Similarly the operation "soldering" can be seen as a class of responses which have a common effect and are under stimulus control. Any set of responses which begins with separated objects and ends with objects being soldered together would be an instance of the operation, "soldering". The response class defining soldering would be comprised of all possible sets of responses which begin with separated objects and end with objects connected by solder.

As with most vocationally viable operations, any instance of soldering will involve a set of responses (i.e., reaching for the soldering iron, picking up the soldering iron, placing the iron on the object(s) to be soldered, etc.). Becker and Engelmann identify these responses as *component operations.* Each is under separate stimulus control and is a member of a response class with a common effect. For example, lifting the soldering iron would be an instance of the component operation, "picking up an object". Becker, Engelmann, and Thomas (1975) have noted the importance of component operations for programming. "The programmer seeks the minimum number of functional units that can be used as building blocks for the maximum number of response sequences," (p. 77). This suggests that one long-range objective for individuals involved in vocational programming needs to be the identification of a minimum number of responses that can be used as building blocks for a maximum number of vocational operations.

A response class can be under stimulus control of a single discriminative stimulus, or under control of a concept. If a concept is taught, any member of a stimulus class will set the occasion for a specific response. In operation learning a stimulus will set the occasion for any instance of a class of responses. When the two are combined, any of a class of stimulus instances will set the occasion for a particular class of responses. When teaching the general task: "put this object on that object", both concepts and operations are involved. The object concepts for the task must be learned, and a set of responses having the common effect of object A ending up on object B will be learned. The learner comes to discriminate the relevant stimulus characteristics which define the concepts, of which objects A and B are instances, and also learns that appropriate responding is dictated not by particular responses, but by the common effects of responding across trials (i.e., object A ending up on object B).

One operation required in assembling a cam switch involves placement of a retaining ring. Figure 7 shows two different cams which require this operation. In each case a tool is used to place a retaining ring on a groove in the

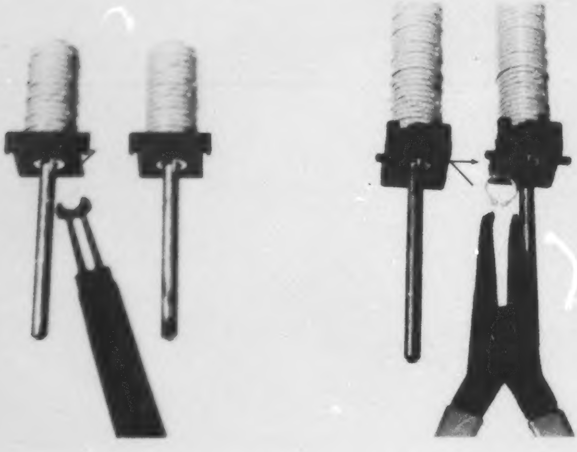
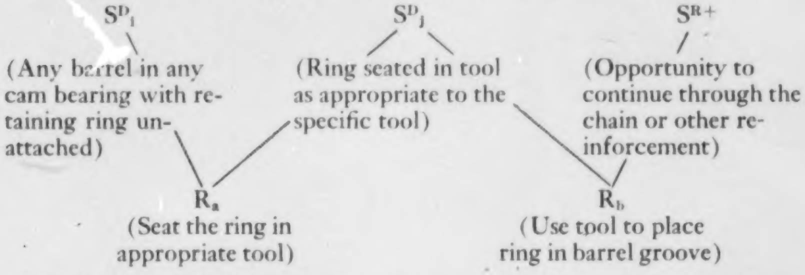


FIGURE 7

Two instances of the operation, "placement of retaining ring."

cam barrel. In each case the effect of this response is that the bearing is fastened to the cam barrel. The way in which the ring is placed, however, varies across the two cams. In cam one the closed side of the ring is placed on a groove in the tool and the tool is then used to push the ring around the groove; in cam two the open end of the ring is held by two points on the tool and the tool is used in a plier-like fashion to spread the ring and place it in the groove. The set of responses required for placing the ring in the second cam differ significantly from those in the first. Both sets of responses, however, produce a common effect (i.e., ring snaps into groove, fastening the bearing to the barrel). This common effect suggests that placement of the ring on cam one and placement of the ring on cam two are members of a response class (placement of retaining rings) which define a single operation.

The addition of operations to the model of a response chain greatly expands the versatility of the model. The designation of a particular response, R_1 is replaced by a class of responses, R_a,which define the operation. A response chain composed of concepts and operations (such as that required for placement of retaining rings) contains a wide variety of stimulus and response possibilities, all of which comprise a conditioned sequence of behavior.


S^D_i
(Any barrel in any cam bearing with retaining ring unattached)
S^D_j
(Ring seated in tool as appropriate to the specific tool)
S^{R+}
(Opportunity to continue through the chain or other reinforcement)
R_a
(Seat the ring in appropriate tool)
R_b
(Use tool to place ring in barrel groove)

Within this model, presentation of any member from the stimulus class, i, will set the occasion for a response from the response class, a. This response will be consequated by a stimulus from the stimulus class, j, and that stimulus will also set the occasion for a response from the response class, b. This response will be consequated with a reinforcer (S^{R+}). In general this model represents a generalized response chain in which concepts and operations are learned.

Teaching Operations

Procedures for teaching operations follow logically from those described for teaching concepts: (a) The learner is presented with task-relevant stimuli and prompted to perform appropriately. (b) Differential reinforcement and corrections are used to define the relevant response effects. (c) A sequence of responses is required which systematically contrasts the effects of the operation being taught from those of alternate operations. Prill (Note 2) applied these procedures to teach the operation of using a socket wrench to a severely retarded adult. (a) She presented the worker initially with one task which required that the correct socket head be selected from 8 different sizes, fit onto a socket handle and used to remove a hex nut. (b) If the worker performed correctly, he was praised. If he performed incorrectly he was corrected. (c) Several additional tasks were presented which varied the size, position and orientation of the nut or bolt. These tasks allowed comparison across tasks of the common effects of the different responses. Even though the worker had to find a socket size he had not used before, and manipulate the wrench in a novel position on new tasks (e.g., from the side rather than the top) he was able to perform accurately with little or no training after learning the first few tasks. This demonstrates the worker's acquisition of the operation of using a socket wrench to remove a nut or bolt.

Implications for Vocational Training

Teaching the general case with respect to concepts and operations appears to have several possible implications for vocational habilitation of the severely retarded. Of particular relevance is the potential impact teaching the general case may have on procedures for vocational training, task analysis, and prevocational programming.

Vocational Training

Severely retarded adults have been taught a variety of vocational skills in workshop programs. However, the competitive industrial community in which these workshops must function places additional demands on training procedures. To be successful, workers generally need to learn a variety of tasks In addition, this learning frequently must be completed in a short time period. Teaching the general case may be one way of responding to these demands.

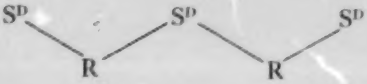
Several concepts and operations can be identified which are likely to be required on tasks available to a workshop. This list could include the performance of operations (e.g., rotating a nut until tight, or using a screwdriver or soldering iron) or differential responding to concepts [e.g., placing the curved side up (Gold, 1972) or matching assembly steps to pictures of the completed task (DeBriere, Note 3)].

Teaching such concepts and operations generally requires more time than would instruction on the specific requirements of a single task, since more examples are used to discriminate instances from non-instances. Practically, therefore, the extra time required to teach a concept or operation will be justified only when there is a reasonable likelihood that it will facilitate performance on later tasks the worker might encounter inside or outside the workshop. To determine whether to teach specific skills or the general case involves some estimation of the behavioral requirements of future tasks. Frequently it is possible to identify concepts and operations that apply across tasks, especially when a variety of similar tasks, like circuit boards (Merwin, 1974), cable harnesses (Hunter & Bellamy, 1976), or cam switches are available. Once concepts and operations are identified in such tasks, systematic instruction can be designed to teach not just specific instances of a concept or operation, but the general case. For instance, if several soldering jobs were anticipated, a worker could be taught not just one soldering task, but several different tasks, each of which involved different responses and different stimuli, but each of which resulted in two parts being soldered together. In this way, the adaptability of a severely retarded worker's skills to realistic work settings might be enhanced.

Training which has emphasized acquisition of concepts and operations also may assist workshop staff in assessing which workers are able to learn new tasks quickly. By comparing the generalized skills learned by workers with the skills required by different tasks, a meshing of task demands and worker competencies can be made. While this would be but one of the variables to consider in assigning a worker to a task, it could be a useful one for workshops dealing with many short term contracts.

Task Analysis

Another implication teaching the general case has for training severely retarded people is in the construction of task analyses. The term task analysis has been used to label a variety of pretraining and training procedures. It is used here simply to indicate the breakdown of a task into component steps, and the sequencing of those steps. The component steps generally indicate the responses required by the task. They are in effect the R's in an operant chain:



Each of these responses, however, is also one instance of an operation, and following training, will be under control of some specific stimulus or a concept. If training is being conducted not just to develop skill on the specific task at hand, but to train a generalized skill, then the task analysis should indicate not simply a response for each step, but the characeristics of the class of responses (i.e., operation) which would be acceptable. Similarly, the trainer should be aware of the characteristics of the class of stimuli (concept), that must come to control responding.

The advantage of utilizing concepts and operations in task analysis is readily apparent in a task which requires soldering. Acceptable solder connections seldom result from repetition of exactly the same movements on task after task. Rather, a class of responses must be taught which is under the stimulus control of characteristics of the melting solder. By specifying this class of responses and its common effect, an acceptable solder connection, the task analysis becomes a much more accurate reflection of actual task demands than would be possible if the analysis were limited to simple responses.

Analysis of a task into concepts and operations has two functions. The first pertains to the way tasks are designed for production. Most tasks can be performed in a variety of different ways. In selecting an assembly method from these options, one relevant concern might be the extent to which concepts and operations were utilized to reduce the number of different movements or discriminations required. For example, the ballpoint pen shown in Figure 8 can be assembled by preparing the upper and lower sections of the pen separately and then putting them together as shown in 8a. This approach requires

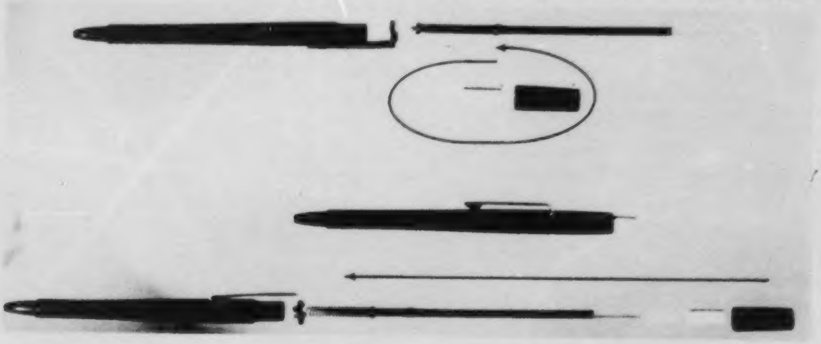


FIGURE 8

Two ways of assembling a ball point pen.

a variety of dissimilar responses. An alternative approach, shown in 8b, requires only two operations (pick up and put on) which are performed with each part. By designing the task to be performed in this latter fashion, several responses with a similar effect are performed. It is likely this approach would facilitate training of the pen assembly.

A second benefit which occurs when a task is analyzed into concepts and operations is that the trainer gains a clear picture of the range of examples the worker will need to experience in order to acquire a generalized skill. When the objective is to teach a generalized skill, this range will typically extend beyond the stimuli available in any one task. If the training is designed to make use of previous acquisition of concepts and operations, the task analysis will indicate the range of examples within a task that need to be experienced. The range of examples will be a function of the number of irrelevant stimulus or response characteristics that must be varied to facilitate performance of certain responses in certain stimulus contexts.

Prevocational Programming

Many facilities serving the severely retarded define their goals in terms of preparing their clients for vocational placement. Typically, skills are taught which are identified as prerequisites for entering a sheltered workshop. These frequently range from simple tasks, such as sorting or folding to training in language, self-help and community living skills. Labeling these skills as prerequisites for vocational training implies that individuals incapable of performing these skills will not be able to master complex vocational tasks. Current research assessing the vocational potential of the severely retarded has clearly indicated that many such "prevocational" skills are not necessary precursors of remunerative vocational employment (Bellamy, Inman, & Schwarz, in press). Workers with very little language, minimal self-help skills and no previous vocational preparation have been able both to learn complex tasks and to perform them consistently over long time periods (Bellamy, Peterson, & Close, 1975; Bellamy, Inman, & Yeates, Note 4). It is becoming increasingly clear that while these "prevocational" skills are valuable in their own right, they need not be classified as prerequisite skills.

Research demonstrating the competence of severely retarded adults to perform complex vocational tasks opens up new alternatives for prevocational facilities. The focus can now shift to training skills that will be directly functional in anticipated vocational settings. This creates a need to both identify those skills most commonly used in workshops, and then teach them. Given, however, that the specific vocational placement of any one worker is difficult to predict, it will not be sufficient to simply teach a worker to perform one task or two. Those tasks may or may not be useful to the worker upon placement. From the viewpoint of teaching the general case, it would seem more functional to identify the most commonly used concepts and operations the worker may encounter, and teach them as generalized skills.

This approach would involve a two-step process. First a workshop or school program would need to assess the tasks that are available within its specific area. Then, the concepts and operations most used across those tasks would need to be identified. While this list would vary from region to region, it might include operations involving tool use (e.g., screwdriver, pliers, soldering iron) or basic assembly (e.g., putting on, screwing a screw or bolt, using a bin set-up to sequence parts for assembly).

However, even if a worker can perform some of these task-relevant operations when s/he enters a vocational setting, a certain amount of training will be required. It is likely that concepts and operations which would be most useful to such a worker would relate to knowing how to obtain information in a training setting. Bellamy, Oliver, and Oliver (in press) suggest that matching a sample is one such operation. This would fit with literature indicating the value of teaching generalized imitation skills in language training (Sloane & McAulay, 1968). Other operations that may facilitate training could include following physical primes, physical cues or verbal cues, requesting assistance and following instructions.

As prevocational workshops and public school programs for the severely retarded become more involved in training complex vocational tasks, there will be an increasing need to identify the specific skills a curriculum should address. While this analysis should be sensitive to the requirements of local communities (i.e., rural vs. urban), it should also identify concepts and operations which would be useful across a wide range of vocational settings.

A prevocational program for the severely retarded will need not only to identify relevant skills, but to implement programming procedures which maximize the utility of skills that are learned. This programming involves defining concepts and operations that are relevant to vocational performance, sequencing these to identify longitudinal instructional objectives, and then designing specific materials to teach each concept and operation. Becker, Engelmann, & Thomas (1975) provide an excellent summary of this process in their discussion of academic skills. Operations should be taught not just as specifi manipulations of specific objects, but as a set of responses, any of which is appropriate if a certain effect is obtained. Similarly the operations learned will be most useful if they are applied across a class of stimuli with common characteristics (a concept), rather than limited to specific stimuli.

For example, in teaching the operation of manipulating parts to match samples, the teacher must do more than teach the learner to match one particular object to a model. Teaching the general case would require that a number of different tasks with different stimuli be presented. The specific responses necessary to match a model (i.e., rotate, turn over, place next to, etc.) will change depending upon the characteristics of each sample. The effect of the responses, however, will always be to manipulate one part so it matches a sample. To the extent that the matching response is performed across a variety of stimuli the match-to-sample operation would be under control of a concept. Training of this nature could greatly facilitate the worker's ability to adapt to a workshop environment in which match-to-sample procedures were used to train new tasks. It is suggested here that teaching the general case with respect to concepts and operations such as those required for matching-to-sample would better equip a worker for active employment than training on one or two simulated tasks.

Conclusion

The vocational potential of severely retarded individuals is being repeatedly confirmed, and the need for well-structured programming of vocational training is apparent. Since many workshop tasks require generalized as well as specific vocational skills, careful consideration should be given to programming and training procedures. Research assessing acquisition of reading and arithmetic skills with disadvantaged children has focused on similar programming needs (Abt Associates, 1976; Becker & Engelmann, 1977; Stallings, 1975). The techniques developing from this research have impressively demonstrated the importance of teaching concepts and operations. The teaching of concepts and operations in vocational settings may be as advantageous as proponents of direct instruction feel they are for teaching reading and arithmetic. These potential advantages surely warrant further empirical assessment.

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Accountability in Habilitation of the Severely Retarded: The Issue of Informed Consent

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Abstract

Normalization and deinstitutionalization trends indicate that retarded adults are going to be returning to or staying in their local communities. The current emphasis on accountability suggests that the educational, recreational and vocational programs designed to meet the needs of retarded adults must comply with legal, social and ethical requirements. One such requirement is informed consent. A legal analysis of informed consent is presented, and implications of this analysis for retarded adults in community settings are outlined.

Accountability in Habilitation of the Severely Retarded: The Issue of Informed Consent

A rapidly expanding body of research indicates that severely retarded individuals are capable of learning complex vocational tasks (Bellamy, Peterson, & Close, 1975; Gold, 1976; Jacobs, 1976; Crosson, Note 1; Martin & Flexer, Note 2; O'Neill & Bellamy, in press). These demonstration studies suggest that severely retarded adults, who have typically been relegated to back wards of state institutions, have the potential to become members of the competitive working force. They further imply that severely retarded people should have access to the training and production options available in community based vocational programs (Bellamy, Note 3; Fox & Karan, 1976; Gold, 1973).

Demonstration that severely retarded adults can be vocationally competent is timely, given the current focus on normalization (Nirje, 1970; Wolfensberger, 1972) and deinstitutionalization. This focus emphasizes that mere placement out of the institution is not a sufficient goal. Retarded people entering the community will need, and have a right to, education, recreation, and the opportunity for meaningful employment. Given the current skill deficits of severely retarded adults in state institutions, access to these activities will necessitate involvement in well structured programs designed to systematically develop adaptive patterns of behavior.

Current research efforts responding to this need indicate that the technology is available to develop community living (Foxx & Azrin, 1973; O'Brien & Azrin, 1972; Robinson-Wilson, 1977; Rusch, Close, Hops, & Agosta, 1976), language (Guess, Sailor, & Baer, 1974; Guralnick, 1976; Schaeffer, Note 4), recreational (Wehman, Blankenship, Edwards, Karan, Renzaglia, & Schutz, Note 5), and vocational (Bellamy, Note 3) skills with retarded people. As structures are developed to facilitate implementation of this technology, a major concern must be inclusion of safeguards protecting the civil rights of this politically vulnerable population.

One legal and ethical safeguard of any treatment, habilitation or research program is the need to obtain consent from participants (Friedman, 1976; Martin, 1975). The present paper examines the implications this requirement has for habilitation of severely retarded adults. An analysis of the legal defiinition of informed consent will be presented. Problems this definition raises for retarded people will be discussed, and suggestions for coping with these problems will be outlined.

Informed Consent

Treatment with the severely retarded, be it in the form of removing an inflamed appendix, soothing of a spastic muscle, training in how to use a toilet, or training to assemble electronic components requires intrusion by the instructor or therapist on the body of the individual receiving the service. It is precisely because of this intrusion that consent is necessary.

The right to be free from physical intrusion by others is a fundamental value protected by law (*Katz v. United States*, 1967; *Mackey v. Procunier*, 1973). As early as 1914 the courts had recognized that, "every human being of adult years and sound mind has a right to determine what shall be done with his (sic) own body . . ." (*Schloendorff v. Society*, 1914, at 93). This right has been upheld more recently in right to privacy cases upholding an individual's right to use contraceptives (*Griswold v. Connecticut*, 1965) and to have an abortion (*Roe v. Wade*, 1973). From these cases it is clear that the state can dictate or interfere in what happens to one's body, only if it can demonstrate a compelling state interest for doing so. Further, physical intrusion by individuals not linked to the state is discouraged through civil assault and battery laws.

Success in community living, and workshop opportunities for severely retarded adults appear dependent on extensive behavioral intervention. Any program offering this type of intervention will intrude on fundamental rights of the individuals being served. Consent is the mechanism that makes this intrusion legally acceptable. Without consent treatment staff are vulnerable to legal suit. The best parallel comes from the long standing need for physicians to obtain consent from their patients prior to administering service. There is substantial precedent that a physician who does not receive consent prior to surgery may be liable for assault and battery (*Canterbury v. Spence*, 1972). It is reasonable to assume that workshop or group home staff implementing behavioral programs without consent will be under similar jeopardy.

As Friedman (1975) and Martin (1975) have pointed out, legally acceptable intrusion does not rest on the quality of the intervention procedures being used, nor on the effects of those procedures, but on the consent of the individual being served. Consent is valid, and recognized by the court only if it is voluntary, knowledgeable and competent (*Kaimowitz v. Michigan*, 1973; *Wyatt v. Aderholt*, 1974). The first two of these criteria dictate requirements largely controlled by individuals who are given consent. The third is focused at attributes of the individual who gives consent.

Consent must be voluntary

The stipulation that consent must be voluntary follows logically from an analysis of consent as the means by which an individual waives a personal right. In general the courts have found that for consent to be voluntary it must, (a) be made in the absence of coercion, and (b) be made with the understanding that at any point the consent can be withdrawn without negative consequence.

In *Relf v. Weinberger* (1974) the court held that voluntary consent "assumes an exercise of free will, and clearly precludes the existence of coercion or force" (at 1202). The *Relf* court examined the constitutionality of the Department of Health, Education and Welfare (HEW) regulations governing sterilizations under federally funded programs. Of central concern was the element of patient voluntariness in consenting to the operation. Plaintiffs claimed that the "voluntary" consent of minors and mentally incompetent individuals was invalid and that adults coerced into consenting could not be said to have given "voluntary" consent. The court concurred.

Further analysis of the voluntary aspect of consent was presented in *Kaimowitz v. Michigan* (1973). Here, the court dealt with a mental patient who had consented in writing to participate as a subject in a neurosurgical experiment. The court found his consent to be invalid on the grounds that it was not voluntary. An overt or indirect element of force, "fraud, deceit, duress, overreaching constraint or coercion" negates the voluntary aspect of consent. The court noted that a promise of early release contingent upon participation in the experiment was sufficient grounds for rejecting the voluntariness of the subject's consent.

The *Kaimowitz* court went beyond the specific case at bar to question the possibility that any patient in a mental institution could give voluntary consent. Using an almost behavioral analysis the court concluded:

> Involuntarily confined mental patients live in an inherently coercive institutional environment. Indirect and subtle psychological coercion has profound effects upon the patient population . . . They are not able to voluntarily give informed consent because of the inherent inequality in their positions. (at 2063)

The significant effect that events in the environment have on a person's behavior suggest it is reasonable to question the degree to which any behavior is truly voluntary (Skinner, 1957, 1971). While the *Kaimowitz* court stopped short of this conclusion it did make clear that the extensive contingency control maintained by staff responsible for incarcerated or severely retarded individuals seriously threatens the extent to which those individuals can be said to consent voluntarily.

Even in the absence of direct coercion the voluntary aspect of a consent may be more readily accepted if a client/subject is also informed that s/he has the right to terminate that consent at any time. A federal circuit court held that the consent of two mental patients to participate in an aversive conditioning program was valid only if they were aware they could withdraw from the program at any time and not suffer denial of privileges or services (*Knecht v. Gillman*, 8th Cir., 1973).

There is no accepted test to determine whether consent is voluntary. In deciding if there has been voluntary consent in a particular case the court will weigh many factors. The *Kaimowitz* court has made it clear that two important factors will be whether the right being waived is a fundamental one, and the degree to which the individual making consent is free from external pressures. (From a behavioral perspective this could be defined as the degree to which the consenting individual is in a position to manage his or her own contingencies.) The *Knecht* court has added that the individual should be informed in writing that s/he can withdraw consent at any time.

In general, the requirement that consent be voluntary is a recognition that decisions a person makes can easily be influenced by those around him or her. The requirement minimizes the impact others might have in the decision-making process and maximizes the likelihood that a person will proceed with his or her own perceived well-being as the primary consideration.

Consent must be knowledgeable

The concept of informed consent assumes that where individual rights are at stake a person will weigh the advantages and disadvantages of a particular proposal. This weighing can only be meaningful if all relevant facts are at one's disposal. In *Brady v. U.S.* (1970) the court stated, "Waivers of constitutional rights must not only be voluntary but must be knowing, intelligent and done with sufficient awareness of the relevant circumstances and likely consequences" (at 748).

While it is clear that consent given without any information is considered no consent at all (*Darrah v. Kite*, 1969), it is not clear how much information is actually necessary for consent to be considered "knowledgeable." Courts addressing this issue within the physician/patient context have used tests varying from "enough information to meet standards of practice in effect in the community" (*Shetter v. Rochelle*, 1965), to all the information the patient "reasonably needs to know to make an intelligent decision" (*Getchell v. Mansfield*, 1971).

In a more recent case a federal district judge ruled that parental consent on a form allowing placement of junior high children in a drug prevention program was invalid because the form did not adequately specify possible risks to the child (*Merriken v. Cressman*, 1973). Judge Davis wrote, "The facts as stated show that letters to the parents were selling devices aimed at gaining consent without giving negative information that would make the parents completely aware of 'the relevant circumstances and likely consequences' of the program" (at 919). Using a test suggested in a *Federal Bar Journal* article (Sheerer & Roston, 1971) the court found that the information provided to parents was insufficient because it was not as extensive as that required of a physician getting consent to conduct surgery. Dicta in *Merriken* suggest the courts will demand a greater disclosure of all relevant facts in situations where constitutional rights and/or extreme risk are involved.

The requirement that consent must be knowledgeable before it is valid is another safeguard established by the courts to protect citizens. It increases the probability that professional individuals seeking consent will objectively and completely present information relevant to the decision at hand. As Martin (1975) has indicated a presentation of relevant information will necessarily be provided in the primary language of the person consenting, and will hopefully be as free from professional jargon as possible. As with the voluntary aspect of consent, the requirements for knowledgeable consent apply most directly to the behavior of persons attempting to gain consent rather than the person giving consent. This emphasis is reversed when considering competence or capacity to give consent.

Consent must be given by a competent individual

The final, and least operationalized criterion for valid consent requires the individual giving consent be "competent." The consenting individual must be able to understand the information being presented, and have the ability to weigh alternatives reasonably. This suggests the person must appreciate that decisions made at one point in time will directly bear on outcomes at a later point. It also implies that the individual will be able to adopt a perspective of self-preservation, and make the decision to consent, only if s/he is convinced it is in his or her best interest.

There have traditionally been two major situations in which individuals have been found incompetent. The first is simply if the person is a minor. The second is if the person is not, in the court's opinion, able to behave adaptively.

In *Relf v. Weinberger* (1974) the court initially stated prerequisites to informed consent were voluntariness, access to necessary information, and "the mental competence to appreciate the significance of that information" (at 1202). It then concluded, "Minors would appear to lack the knowledge, maturity and judgment to satisfy these standards . . ." (at 1202). The court later qualified this statement maintaining that, while "minors are not legally incompetent for all purposes," the basic right to procreate is of such importance that a strict view of competency is necessary. This would imply that children may be competent under the law to waive some rights, but not all.

The unwillingness of the court to completely deny the competency of children is also addressed in dicta in *Merriken*, and points out the true dilemma of any standard of competency. On one hand the law must protect those unable to reasonably monitor their rights, and on the other hand this protection must not be so strictly constructed that an overpaternalistic state is undermining self-determination (Friedman, 1975).

Just how to determine if an individual is not mentally competent has not been well established. In an excellent analysis of competency and mental health Friedman (1975) has identified three standards that have been used. The first requires a reviewer to decide whether the result of the client's decision is one which a "reasonably competent person might have made." A second standard would require the court to determine if the client had the "capacity to weigh the risks and benefits, and reach a decision for rational reasons." The third standard would avoid the necessity to determine if the client was behaving "reasonably" and merely ascertain if s/he had the "capacity to understand what risks and benefits were involved," and make a choice.

Each of these criteria may be defective when applied to a set of facts different from those that spawned it. Each requires a highly value-laden decision to be made by a third party. As such, each is open to misjudgment and abuse by individuals in the position to make that decision.

The underlying theme of the three standards is clear, however. There are a variety of mental states that can prevent an individual from behaving in his or her own best interest. The concept of informed consent, however, is based squarely on the assumption that the individual giving that consent will hold foremost his or her best interest. When such is not the case the purpose of consent collapses. The guidelines presented above are attempts to operationalize just when a person can no longer act in his or her best interest. Their inadequacy stems partly from the fact that competency is as situation-specific as it is person-specific, and partly from the extreme difficulty of defining observable behaviors that reliably characterize incompetent people. Until a more operational structure is developed it appears the courts will determine competency on a case-by-case basis using the guidelines described above.

Implications

Severe mental retardation is a label typically applied to individuals who are unable to reliably understand and act upon information in a manner that is in their best interest. In most states, however, being classified severely retarded does not automatically include a classification of legal incompetence. Some states assume that entry into a mental institution establishes legal incompetence; most, however, require a separate hearing addressing the specific issue of competence before a person can be considered legally incompetent (Friedman, 1976).

A severely retarded individual who has reached majority age and not been declared incompetent is legally capable of giving informed consent. Were that consent challenged in a court of law, however, and the individual found to be incompetent, the prior consent would be nullified and presumed to never have existed.

As severely and profoundly retarded people re-enter the community, state and private programs will be required to provide the training necessary for them to become adaptive members of the community. Involvement in these programs will require informed consent, yet in many cases the possible inadequacy of this consent may raise serious legal problems for those concerned with habilitation of severely retarded adults.

A growing number of individuals serving the retarded are accepting the need for accountability in program management. The first step toward accountability is obtaining informed consent from each individual entering a treatment facility or behavior modification program. With programs serving handicapped children this consent can legally come from the parent or guardian. For those serving handicapped adults the consent must come directly from those individuals capable of acting in their own best interest, or from guardians of those individuals declared legally incompetent. For the large number of severely and profoundly retarded adults who have not been declared incompetent, but would be if a hearing were held, there is no immediately viable solution. Frequently these individuals are placed in residential settings and enrolled in treatment programs without any informed consent. It is quite possible this process and the treatment provided violate due process (*Clonce vs. Richardson*, 1974) and privacy rights of the clients, and will come under close scrutiny by the courts as the rights of mentally retarded people are more clearly defined.

Guardianship

The legal remedy for those facilities serving severely retarded adults involves implementing court proceedings to have clients/workers/subjects declared legally incompetent and provided with a guardian who can give consent. This option, as presently defined, is viewed as less than a panacea by educators and service providers dedicated to normalization and deinstitutionalization. The legal process itself is long and costly. The removal of rights is generally overinclusive and there is serious reason to question whether the appointment of a guardian is in the best interest of the "incompetent" individual.

The legal process

Guardianship laws vary across states both in procedures for declaring a guardian and in the role a guardian plays. Oregon's law, which is representative of the majority, defines an incompetent person as "a person who is unable, without assistance, to properly manage or take care of himself or his (sic) affairs" (ORS 126.003). In defining the process by which a person is declared incompetent, Oregon law stipulates that: a) guardianship proceedings can be initiated by *any* person filing a petition for a finding of incompetency (ORS 126.103); b) notice of the petition and the impending hearing must then be personally delivered to the "alleged incapacitated person" within 10 days. This notice must contain all pertinent information concerning the time, place and purpose for the hearing (ORS 126.007); c) if objections are raised the court "may" appoint an attorney for the alleged incompetent person, and "may" ask that a physician conduct an exam (ORS 126. 103); d) the court "may" also send a "visitor" to interview the alleged incapacited person, the prospective guardian and the physician; e) the court "may" allow the alleged incapacitated person and counsel to be present during the hearing and to present evidence and cross examine witnesses (ORS 126.103).

While Oregon law suggests a number of procedures to safeguard due process rights none are mandatory, except delivery of a notice. Even if strong opposition to the petition existed the court could legally declare any individual incompetent and assign a guardian without ever seeing the alleged incompetent.

California has recently enacted legislation that attempts to protect the due process rights of an alleged incompetent person (AB. 1417, 1976). The legislation guarantees, a) the right to a notice indicating the time and place of the guardianship hearing, the legal standard to be used in determining incompetency, and the nature and consequences of the hearing; b) the right to representation by counsel; c) the right to a jury trial; and d) review of the guardianship status every six months. The new law also attempts to redefine incompetency in a legal rather than medical manner. Under the new law an individual can be found incompetent when s/he "is unable to provide for his (sic) own personal needs for physical health, food, clothing or shelter, and in the case of a guardianship of the estate, is substantially unable to manage his (sic) own financial resources."

While this definition still requires an extremely value-laden opinion from the court concerning just when someone is "unable to provide. . .", it does point out that competency extends across many different aspects of an individual's life. One may have the skills necessary to manage one's own health, food, and clothing yet not be able to manage monetary affairs. Incompetency is not part of a person, but a recognition of skill deficit. This suggests a person is not afflicted with incompetency, but lacking in training.

Guardianship is generally overinclusive

The sole purpose of a guardian is to ensure that the legal and personal actions of an individual will be made in his or her best interest. Within this framework behaving in one's best interest can be translated as performing the skills necessary for survival in society. When an individual in our society is unable to demonstrate skill in the behavioral areas required for survival, s/he is declared incompetent and a competent (i.e., skilled) individual acts on his or her behalf. Important to a comprehensive understanding of competence is a recognition of the role the environment (physical, social and political) plays in its definition. A person raised in one culture will develop the skills necessary for survival in that culture. If s/he were transported to a very different cultural setting those skills could easily be non-functional and s/he would be incompetent. Hence, the key to competent behavior within any societal framework is access to training opportunities. The competent performance by severely retarded individuals in vocational training situations (Bellamy, Peterson, & Close, 1975; Gold, 1976; O'Neill & Bellamy, in press) suggests that these individuals do have the "capacity" to learn many of the survival skills required of competent members of our society, but have not had access to the specialized training opportunities they require.

If one views competence not as a single, all-inclusive trait, but as the acquisition of specific skills, laws related to incompetence take on a new perspective. Clearly, as one learns new skills s/he becomes more competent in that area of expertise. If some skills are learned and others not learned an individual could easily be "partially competent." Given the fundamental importance of liberty in our judicial structure it would seem highly suspect for a partially competent person to lose all his or her legal power. A much more equitable solution would be a declaration of partial incompetence. Friedman (1976) has addressed this point:

> A person may be competent to perform some acts but not others—for example, incapable of managing complicated financial affairs but able to handle personal matters well. The law should recognize this person's competence in the latter area and treat him (sic) only as financially incompetent. (at 43)

Carrying this argument to its logical conclusion would result in a list of skills defining a competent individual. A declaration of incompetence would then require observing that a particular person in a particular environment was incapable of performing important adaptive skills.

While most states deal with competence as an all or nothing issue a small minority are recognizing item-specific incompetence (e.g., Michigan Statutes Ann. § 14.800(620) and Minnesota Statutes Ann. § 252A.11). House Bill 599 recently passed by the Idaho legislature provides "that guardianship shall be ordered only to the extent necessitated by the actual mental and adaptive limitations." These are encouraging changes, and are badly needed in other states. The failure last year of an Alaska bill (H.B. 734, 1976), which closely resembled Idaho's, indicates these changes will not be unopposed.

Guardianship and conflict of interest

A final problem with present guardianship laws stems from the extensive financial and emotional burden frequently placed on the guardian of an incompetent individual. Generally a guardian is someone who is related or closely tied to the incompetent. Even in these situations, however, the burden placed on a guardian can easily create a conflict between doing what is in the best interest of the incompetent person versus doing what is most expedient for the guardian. In *Saville v. Treadway* (1974) the courts recognized this conflict in denying a parent the right to consent to placement of his child in a mental hospital on the grounds that the decision was not in the best interest of the child.

Severely retarded individuals within our society do not generally exhibit those skills required for survival. This can be attributed to a number of factors, including the fact that a) the severely retarded do not learn as readily as normals (Prehm, 1976); b) they generally have not had access to the specialized training they would need to acquire adaptive skills; and c) they are frequently placed in bizarre environments which do not facilitate learning of adaptive skills, and commonly support maladaptive behavior. Because skill deficits do exist, severely retarded people entering the community will require access to mechanisms to safeguard their rights. Concerning the specific right to informed consent, guardianship is the only legal option available.

As more retarded individuals interact with the "normal" environment the need for more progressive guardianship laws will increase. Current needs include, a) an operational analysis of competency which recognizes that an individual can be partially competent; b) a reduction in the temporal and financial cost to obtain a guardian; c) provisions to decrease the burden of guardianship and protect against "conflict of interest decisions," and d) a mechanism other than state protection to make the advantages of guardianship available to adults who do not have access to relatives or friends who can serve in the traditional guardian role. Clearly, guardianship laws are in need of revision, and are worth the time and effort necessary to produce revision. Advocacy directed at changing guardianship laws is at best, however, a long range solution. Effort must also be directed toward coping with the legal needs of severely retarded individuals who are presently entering the community.

An alternative to informed consent

There is no legal alternative to informed consent. The fundamental rights of an individual can only be legally managed by that individual, or a court appointed proxy. This might suggest that incompetent individuals should not enter treatment facilities without first being declared incompetent and provided with a guardian who could supply proper informed consent. Clearly this is not the current trend, nor should it be.

Retarded adults with the ability to learn and perform many of the social and vocational survival skills required by our society are leaving institutions for community-based residences. If the needs of these people in the community are to be met, comprehensive treatment programs must be provided. In lieu of more appropriate guardianship legislation, any facility serving incompetent adults who have not been declared incompetent should make special provisions toward accountability in the services provided. These provisions should at minimum include: a) individualized treatment plans which identify operational objectives, and treatment procedures, b) an evaluation system that provides frequent feedback on the effects of treatment, and c) systematic review of treatment procedures by qualified, objective personnel. Procedures such as these will probably not satisfy current legal requirements, but may functionally ensure that an objective advocate is considering the best interest of each person being served.

The one mechanism holding most promise for protecting the rights of the retarded is the use of a committee to review procedures and programs. In *Wyatt v. Aderholt* (1974) a review committee composed of court approved members was established to approve and review all sterilizations conducted at Partlow State School. The use of an unaffiliated review committee by treatment facilities has also been recommended by Friedman (1975). He suggests a state-wide "Peer Review Committee" be appointed in each state by the governor. This committee would review programs or particular behavioral procedures specifically designed for an individual or group of individuals. Approval would be based on a finding that the procedure is effective for strengthening or weakening specified behaviors, and that the design of the procedure is professionally sound. Friedman also suggests that regional Human Rights Committees be established to receive and investigate complaints lodged by clients, parents, staff or the public concerning ongoing programs. While an impartial review committee cannot legally substitute for informed consent, it would appear to be the best approximation currently available.

It is doubtful if a state-wide review committee could begin to monitor the multitude of programming decisions that are hopefully being made today. To be effective a review committee may need to exist for every county or facility serving incompetent individuals. The committee should be composed of members not affiliated with the facility, who are from the immediate community, and/or are competent behavioral programmers, and/or have medical expertise, and/or have legal expertise, and/or have experience with the population being served. It is unclear what structure would best facilitate the committee's monitoring of program decisions, but it would be imperative that appropriate power, autonomy, and access to information reside with the committee. The suggestions provided in litigation (*Wyatt v. Aderholt*, 1974) and scholarly reviews (Friedman, 1975) should prove useful in developing the organization and function of review committees.

Safeguards are necessary to protect the rights of severely retarded adults, both in institutions and in the community. The development of objective, review committees for all facilities serving this population will facilitate both protection of human rights and more accountable service. In addition, the continuing redesign of guardianship laws will hopefully provide a nexus between the increase in treatment accountability and the legal requirements for informed consent.

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Habilitation of the Severely and Profoundly Retarded: An Applied Research Perspective

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Habilitation of the Severely and Profoundly Retarded: An Applied Research Perspective

The applied research program described here is designed to examine the sources of variability in vocational habilitation outcomes with severely and profoundly retarded adults. The research is a direct result of the problems and issues encountered in the Specialized Training Program, a model community program for these adults. The purpose of the research is to identify efficient habilitation techniques for use in community programs.

Development of the Specialized Training Program

The need for increased community opportunities for the severely and profoundly retarded is readily apparent when general residence trends are examined. Despite the continued prevalence of institutional care for this group (Rowitz, O'Connor, & Boroskin, 1975), there are several indications that community residence will increase dramatically during the next few years. For example, the initial need for institutionalization of severely handicapped children is being reduced by the increasing provision of public school services to all children. Many other retarded individuals are being returned to community life as policies of deinstitutionalization are implemented in various states. Community residential facilities are now developing to supplement available family and foster care (O'Connor, 1976; Skarnulis, 1976). As community residents, these severely and profoundly retarded adults will have every right to expect services and opportunities like those which are available to others—adult education, recreational opportunities, and a chance to perform meaningful work.

The Specialized Training Program was begun three years ago at the University of Oregon as a model community program which would provide some of the needed services. The emphasis of the program was on vocational opportunities, and its purpose was to provide a replicable community service in which severely and profoundly retarded adults could perform challenging work for competitive wages.

To maximize replicability, the program was designed to serve a representative group from the population of severely and profoundly retarded adults who are likely to become community residents during the next few years. Representativeness was insured by selecting 11 of the 15 participants by somewhat random procedures: Six were included as all the known adults within commuting distance who were ambulatory and free of significant sensory deficits. Five other were included by random selection of institution residents from this county who met the same criteria.

In the Specialized Training Program these adults are taught to perform a variety of assembly tasks which are subcontracted from regional electronics industries. Then, after learning any particular task, they have the opportunity to earn piece-rate wages in a structured production setting.

The research program described here has resulted from the problems, frustrations, failures, and to some extent, the successes, which have been experienced in providing these community services. Although the needed research will no doubt occupy us for years to come, the initial results have enabled us to establish a service–research–service feedback loop in which problems or failures with individual adults were identified as areas for research. The research was then conducted, both in the program itself and in a cooperating institutional setting. Finally, relevant findings were used to change procedures in the service program. The purpose of this paper is to describe some research needs which have become apparent in the development of the Specialized Training Program and to present examples of current research related to some of those needs.

Overview of the Research Program

Rapid acquisition and normal rates of performance of vocational skills are vitally important outcomes in community habilitation programs for the severely and profoundly retarded. Variations in time required for training a particular task may have significant effects on the type of contracts sought, the staffing patterns needed in workshops, and the inclination of professional staff to provide the needed training. The importance of individual productivity is also apparent. The practical utility of the vocational skills learned will depend to a large extent on the rates at which the skills are ultimately performed and the kind of supervision required to maintain those rates. Production rate is not only the basis for remuneration in all sheltered employment, but it also directly affects the overhead income of workshop programs and thus determines their economic viability and subsidy needs.

In our research, these outcomes—acquisition time and productivity—are the dependent measures whose variability must be explained. That considerable variation exists in both measures is well documented, with obvious differences reported across time, settings and persons on both measures. (See, for example, Bellamy and Snyder, 1976; Gold, 1972; Gold and Barclay, 1973a, 1973b; and Irvin, 1976 for variability in training time, and Bellamy, Note 1, for a review of research on productivity.)

Experience in the Specialized Training Program has focused our attention on three general sets of independent variables which may account for variation in acquisition and performance measures. Each of these sets of independent variables relates directly to classes of decisions which must be made in community habilitation programs. They are: (a) characteristics of the work tasks, (b) characteristics of the individual workers, and (c) aspects of the training and performance setting. An overview of the research program is presented schematically in Table 1. The intersection of each dependent with each independent variable represents an area of research which could have important implications for service delivery. An overview of our research interests in each area will be presented here. Until now, much of our work has focused on two of these areas, and examples of that work will be presented.

Setting-Procedural Characteristics

Independent variables considered in this part of the research program are aspects of the physical and social setting in which a task is either learned or performed. Of specific interest are the effects of variations in training and supervision procedures. If such effects can be reliably demonstrated, implications for daily program operation are immediate.

Dependent Variables ⇨ Independent Variables ⇩	Skill Acquisition	Productivity
Task Characteristics		
Personological (Worker) Variables		
Setting / Procedural Characteristics		

TABLE 1

Overview of Research Needs

Relationships with Acquisition Measures

Research in this area has focused on assessment of general utility and relative efficacy of different skill acquisition training strategies. The questions that guide this research are not based on "whether" training procedures can be devised to facilitate vocational skill acquisition by severely and profoundly retarded adults. A number of research and application efforts have convincingly demonstrated that, indeed, such training procedures can be devised: oscilloscope cam switch assembly (Bellamy, Peterson, & Close, 1975); bicycle brake assembly (Gold, 1972); and cable harness construction (Hunter & Bellamy, 1976) have all been performed by such adults. Thus, the current research focuses on "how" best to implement assembly skill training given the array of possible training strategies.

Two recently completed related studies will be reviewed here (Irvin, 1976; Irvin & Bellamy, 1977), and several others currently underway will be described briefly. Both of the completed studies derived from the Attention Theory of Zeaman and House (1963) and evidence from other research (Gold, 1972; Gold & Barclay, 1973b) that demonstrates that retarded persons do not attend to, or perceive as relevant, the relevant dimension in a discrimination task. That is, they do not know what the *problem* is in such a task for any of a number of reasons—lack of appropriate experience, lack of operational language skills, etc. In addition, traditional discrimination training techniques involving reinforcement for correct responses consistently fail to teach the problem. Once the *problem* is learned, though, the solution is learned via differential reinforcement just as for non-retarded individuals. This characteristic has direct implications for assembly skill training for these persons, in that most complex assemblies involve a number of difficult visual discriminations.

The most common application of Attention Theory to skill training contexts has involved development of various stimulus feature manipulation strategies that facilitate learning of the discrimination "problem" by retarded individuals. One such technique involves teaching a series of easier-to-harder discriminations to facilitate later learning of a difficult criterion discrimination (Gold & Barclay, 1973b; House & Zeaman, 1960). The first recently completed study focused on assessing the general applicability of this procedure for assembly skill training of severely and profoundly retarded individuals (Irvin, 1976).

The task involved learning to place a bicycle axle nut with one flat face and one very slightly raised face on an axle post with the flat side down. The research participants were 24 randomly selected severely retarded residents of a state institution. The training procedures involved teaching a series of three lock nut/axle assemblies, where the initially presented set of lock nuts had one flat face and one face raised nearly one-half inch. Subsequent sets had successively less difference between the two faces of the nut. Twenty consecutively correct assemblies were required before movement to the next difficult set of training objects.

At the beginning of the initial training session, modeling and full physical prompts were used to teach subjects the required sequence of movements. Once participants correctly performed the required movements, criterion discrimination training began. The experimenter modeled the entire task again and asked the subject to "do the rest." Measures of discrimination were taken at the point that the subject evidenced satisfaction with the position of the axle nut in the left hand by reaching for an axle post with the right hand. For every discrimination error, a correction procedure was instituted. The experimenter provided verbal cues ("no" or "turn it over") or full or faded physical prompts to teach the subject the correct positioning of the nut. Only one measure per trial was taken; subject's responses to corrections were not scored. After every correct discrimination or completed trial, the experimenter said, "Good," "Excellent," "Yes," etc., and patted the subject on the back or arms.

The results of the study demonstrated that such easy-to-hard discrimination training procedures could indeed facilitate difficult discrimination assembly skill acquisition by severely retarded learners. However, because seven of the 24 participants did not learn the task, and because many trials and errors were required and made by many of those 17 who did succeed, the results were interpreted as suggesting that such procedures may have substantial limitations in applied training settings; effective training objects may often be time-consuming, difficult and expensive to construct or acquire, and trainers' perceptions of what constitutes an "easy" version of a difficult discrimination may not be accurate.

The purpose of the second recently completed study (Irvin & Bellamy, 1977) was to compare the relative efficacy of three approaches to difficult discrimination training for severely and profoundly retarded individuals working with an assembly task: (a) the easy-to-hard approach described above (Adding and Reducing Large Cue Differences (ARLCD) on the relevant dimension); (b) adding and fading of a redundant color dimension (AFRD) (Gold, 1972; Sidman & Stoddard, 1967; Touchette, 1969; Ullman & Routh, 1971; Zeaman & House, 1963); and (c) a combined ARLCD/AFRD technique. The combined ARLCD/AFRD procedures were devised specifically for this study to minimize, as much as possible, the large numbers of training trials and considerable variability that appear to result when ARLCD or AFRD techniques are employed alone (Gold, 1972, 1974; Gold & Barclay, 1973b).

Half of the residents of the state institution who had IQ/SQ in the range of 15-40, no vision deficits or crippling conditions that would impair performance, no previous vocational skill training and who were age 16 years or older were randomly selected as research subjects. These 102 individuals were randomly assigned to three training groups, 34 to each. Seventeen in each group were trained and achieved criterion prior to project termination.

The task involved learning to place a bicycle axle nut with one flat face and one very slightly raised face on an axle post with the flat side down. The three different training procedures involved: (a) teaching a series of three lock nut/axle assemblies where the initially presented set of lock nuts had one flat face and one face raised nearly one-half inch and subsequent sets had successively less difference between the two faces of the nut (ARLCD); (b) teaching a series of three axle nut/axle assemblies where the initially presented set of axle nuts had red coloring of high intensity applied to the slightly raised face and subsequent sets had successively less intensities of red coloring applied (AFRD); and (c) teaching a series of three lock nut/axle assemblies where the initially presented set of lock nuts had one flat face and one face raised nearly one-half inch *and* red coloring of high intensity applied to the raised face, with subsequent sets having successively less intensities of red coloring applied to the raised faces (Combined ARLCD/AFRD). Each training approach involved three training phases and the final criterion discrimination acquisition phase. Twenty consecutive correct assemblies were required before movement to the next difficult training phase.

The training procedures were the same for all subjects in all three groups, and involved the same demonstration, training, correction, reinforcement and data collection techniques described in the earlier study. Only the features of the training stimuli differed.

The results of the study demonstrated reliable trial and error effects due to type of training and phase of training. All groups significantly differed from one another in trials and errors to *phase one* criterion, with combined ARLCD/AFRD training producing by far the least trials and errors, AFRD training producing the next least, and ARLCD training effecting numerous trials and errors to phase one criterion. In addition, errors decreased significantly and substantially between phases one and two of ARLCD and AFRD training (those treatments producing the most errors initially).

These results demonstrate that: (a) the initial simultaneous presence of a redundant color dimension and exaggerated cues on a relevant dimension facilitated learning substantially better than did either individually; and that (b) color coding/fading procedures were substantially more effective than the easy-to-hard approach. In addition, it appears that these relative efficacy results derive primarily from the differential effectiveness of the training procedures for establishing immediate and powerful stimulus control in the initial phase of training.

The finding that the presence of color as a redundant dimension appears to facilitate acquisition more quickly and errorlessly than does exaggerated cue difference on the relevent dimension must be qualified. The materials for ARLCD training were purposefully restricted to readily accessible assembly objects. The rationale was that a training procedure has utility in a vocational skill training context only if its components are implementable. The implications of stimulus variable research for application to practical settings are limited unless such a rationale for procedures is adopted.

The finding that color cues are powerful initial training aids is important because color coding/fading techniques are so widely applicable and easy to implement. Color coding procedures can be used for initial assembly training involving difficult visual discriminations and simple fading procedures can be used to move individuals toward skilled production.

An additional implication involves the importance of minimizing errors because of the possible debilitating effects of failure on severely and profoundly retarded learners (Bialer & Cromwell, 1965; Gold & Barclay, 1973b; Zeaman & House, 1960). It was evident throughout the study that relatively errorless learning tended to eliminate "emotional" responses incompatible with correct performance.

Finally, because 14 of the participants did not learn the task—three in the combined ARLCD/AFRD training, four in the color coding/fading (AFRD) training, and seven in the ARLCD easy-to-hard training—it was concluded that none of the procedures may be effective for a small proportion of profoundly and severely retarded "difficult to train" individuals. More research is clearly required to identify efficient training procedures for such learners.

Some studies currently underway focus on further clarification of the impact of these stimulus features-based training techniques, and others on different aspects of training technique variables for teaching assembly skills to severely and profoundly retarded persons. Three additional stimulus-factor research efforts have been initiated as a result of the findings reviewed above. The effects of different stimulus feature manipulation training on retention/relearning are being examined, the applicability of the color coding/fading technique to more complex tasks is being assessed, and the relative efficacy of color coding/fading and a faded match-to-sample procedure is being investigated. In addition, other studies have been designed to: (a) assess the utility of a generalized match-to-sample training procedure; (b) examine the relative efficacy of backward and forward chaining techniques for differing tasks; and (c) investigate the differences between large and small step chaining procedures for varying tasks. The purpose of the current and ongoing research is to contribute to the development of systematic methodology for the vocational skill training of severely and profoundly retarded individuals.

Relationships with Productivity

Previous research on work rates of retarded persons has suggested that several aspects of the performance setting can affect work rates These are extensively reviewed elsewhere and will be outlined here. Three setting characteristics appear particularly important, including supervisor instructions which precede work performance, consequences for work, and general setting characteristics. Instructions which specify desired performance (Evans & Spradlin, 1966; Gordon, O'Connor, & Tizard, 1955; Headrick, 1963; Huddle, 1967, Hunt & Zimmerman, 1970), instructions which encourage competition (Gordon, O'Connor, & Tizard, 1955; Huddle, 1967), and instructions which set performance goals (Gordon, O'Connor, & Tizard, 1954; Kleibhahn, 1967; Zimmerman, Overpeck, Eisenberg, & Garlick, 1969) have all been related to productivity of retarded workers. The effects on productivity of consequences for work has been extensively examined, primarily resulting from an interest in applying principles of operant conditioning to workshop operation (Campbell, 1971; Linde, 1962). That positive consequences can be found which do, in fact, increase the work rates of retarded individuals has been demonstrated with consequences such as money (Brown, VanDeventer, Perlmutter, Jones, & Sontag, 1972; Evans & Spradlin, 1966; Huddle, 1967; Schroeder, 1972), music (Bellamy & Sontag, 1973; Cotter, 1971; Podvin, 1967), edibles (Brown, Johnson, Gadberry, & Fenrick, 1971), choice of work assignment (Zimmerman, Overpeck, Eisenberg, & Garlick, 1969), increased frequency of supervisor contact (Bellamy, Peterson, & Close, 1975), and knowledge of results (Jens & Shores, 1969; Levy, 1974). General setting characteristics which can affect productivity include the presence of a more competent co-worker (Abel, 1938; Brown & Pearce, 1970; Kleibhahn, 1967), supervision style (Tizard, 1953), and amount of environmental distraction (Somervill, Jacobsen, Warnberg, & Young, 1974).

Extensive as this research is, it does not yet provide the needed empirical basis for the design of efficient work settings for the severely and profoundly retarded. Experience in the Specialized Training Program suggests that research which is now needed should focus on: (a) use and evaluation of practical supervision procedures, given typical staff ratios in applied settings; (b) evaluation of these procedures with more severely handicapped individuals than those typically served in sheltered workshops; (c) evaluation of procedures over extended time periods which approximate the long-range function of community work programs; and (d) development of measurement systems which allow for continuous monitoring of both productivity and other behaviors of habilitative interest.

Task Characteristics

Independent variables studied as task characteristics are measurable properties of the work tasks themselves. These are specified through a description of the behavior chain required for task completion and include both the behaviors involved and the discriminations which must be made. Relationships between task characteristics and either acquisition or performance measures could have important implications for task selection and task analysis in workshop facilities.

Relationships with Acquisition Measures

It is apparent from a common sense perspective that some tasks are more difficult to learn than others and could naturally be expected to require more training time. Summary labels like task complexity thus have a great deal of subjective appeal. Little is really known, however, of the specific task characteristics responsible for this difficulty, and thus little direction is given to those who must make decisions about task selection and analysis. Research on attention theory (Zeaman & House, 1963) has identified some relationships between type of discrimination and learning difficulty. Several additional questions remain, however, especially concerning the effects of various movement characteristics and the possible interactions between movement and discrimination characteristics. Our research in this area focuses on the effects on learning rates of several task dimensions on which difficulty sequences seem possible: (a) type of discrimination, (b) number of simultaneous discriminations, (c) type of response (force, tedium, etc.), and (d) number of simultaneous movements required.

Relationships with Productivity

Several authors have observed that task variables like novelty (Kahn & Burdett, 1967; Tate & Barhoff, 1967), cycle time (Gold, 1973a), and complexity

(Gold, 1973b) seem related to productivity. Relatively little research is available, however. Exemplary of the needed work is Schroeder's (1972) report of the effects of response force on productivity under different schedules of reinforcement. Our first research on this issue will be an examination of whether different types of tasks have different levels of stimulus control over workers' tasks attending behaviors.

Person (Worker) Characteristics

Independent variables of concern in this aspect of the research program are measurable attributes, experiences or abilities of individual workers. Relationships between these variables and habilitation outcomes could provide an empirical basis for selection or assignment of individual workers in different kinds of programs.

Much of the existing vocational assessment research has involved attempts to predict some measure of productivity from such personological variables as IQ (Appell, Williams, & Fishell, 1962; Tobias, 1960), performance on manual dexterity tests (Elkin, 1965, 1968; Wagner & Hawver, 1965), learning rates (Ladas, 1960) and other variables. The practical utility of this research has been ably criticized by a number of authors, both on the basis of pervasive methodological weaknesses and because of the generally low correlations obtained (Gold, 1973a; Windle, 1962; Wolfensberger, 1967). Although the weakness of observed relationships could be due to unreliability and restricted ranges of both predictor and outcome measures, the currently available results offer little encouragement for continuing this area of research. In fact, Neff (1970) has suggested that the assessment researcher's interest in accounting for variability in ultimate productivity might be best served if more attention were focused on aspects of the work setting, rather than the individual. This area of research has also been criticized because it has fostered testing practices that tend to exclude many severely handicapped individuals (Gold, 1973a) who are clearly capable of high levels of productivity under certain conditions. Clearly an important concern, this criticism of current testing practices does not reduce the necessity, given current service levels, to make placement decisions on some basis, whether or not an adequate empirical foundation is available.

A somewhat different interest in personological variables has grown out of the Specialized Training Program, namely the prediction of learning rates on assembly tasks. Variability among trainees is well documented. (See, for example, Bellamy and Snyder, 1976; Gold, 1972; Gold and Barclay, 1973a, 1973b; and Hunter and Bellamy, 1976.) From a practical standpoint, this large variability means that some severely retarded individuals will be much more expensive to serve than others. If we could predict relative training time needed by potential trainees, an empirical basis for program placement could be provided: Programs with varying training resources could serve individuals who were likely to require corresponding amounts of training. Until habilitation programs are available to all severely and profoundly retarded adults, such an instrument might provide a basis for estimating habilitation costs, and thus promote the use of a "practicality" criterion rather than a "feasibility" criterion for acceptance by vocational rehabilitation agencies.

The Trainee Performance Sample (Bellamy & Snyder, 1976) was designed to explore this prediction possibility. The 30 items on the test were selected from a domain of structured situations like those in which a trainee could be expected to respond in small parts assembly training. Specifically, all items were structured to: (a) require the individual to make a specific object manipulation or assume a defined hand position; (b) require that this movement be performed after a specifically defined trainer cue, involving a verbal direction and either a model or physical prime; (c) necessitate that the individual make a defined discrimination to complete the movement correctly; and (d) allow the individual to respond a second time to the same task, immediately following a repetition of the trainer cue if the first task was incorrect and a presumed reinforcer if the first attempt was correct.

Initial research on the instrument (Bellamy & Snyder, 1976) involved administration to 305 adult residents of the Fairview Hospital and Training Center who were labeled severely or profoundly retarded in institutional records. The test was readministered to a random sub-sample of 50 adults after one year. Other sub-samples received vocational training on selected small-parts assembly tasks. An item analysis of the 305 performances indicated that the 30 items formed a cohesive set (coefficient alpha is above .91). Readministration after one year indicated a significant gain in scores but stability of relative ranks. Current research is exploring possible explanations of this score increase and further evaluating test-retest reliability. Correlations between test scores and training time were computed for a total of seven training groups (sample sizes ranged from nine to 15) who learned one of three tasks by specifically defined procedures. (See Bellamy and Snyder, 1976; Irvin, 1976; and Irvin and Bellamy, 1977.) Six of the seven correlations were statistically significant, and in four of the seven more than 50 percent of the variance in training time was accounted for by test scores. Current research on this instrument focuses on discovering relationships with existing tests and evaluating its utility in other applied settings.

Conclusion

These research interests and directions reflect the problems encountered in one community program which provides vocational opportunities to severely and profoundly retarded adults. They are by no means exhaustive. A variety of other research needs are clearly important in the development of habilitation procedures. For example, the many possible interactions between person, task, and setting variables should be investigated. Practical issues in competitive job placement need attention. Techniques for efficient training of trainers must be identified and evaluated.

The practical nature of this research program follows directly from the close connection between the research and service aspects of the Specialized Training Program. Individuals charged with providing service need a great deal of information from researchers. If this information is to be utilized effectively, there must be some agreement between service and research professionals on what questions need to be asked and what kinds of solutions are practical in applied service settings.

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PART II

Evaluation of Habilitation Procedures

Stimulus Control, Transfer and Maintenance of Upright Walking Posture with a Severely Retarded Adult

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Abstract

The extent to which behavorial interventions achieve clinical significance frequently rests not simply on whether a response or set of responses can be brought under stimulus control, but whether gains made during an intervention transfer across settings, and maintain over time. Critical to this measure of significance is the extent to which manipulation of variables in one setting affects responding in other settings. The present study describes a method of obtaining stimulus control of upright walking posture with one severely retarded adult, and examines the effects varying antecedent and consequent variables in a training setting have on upright posture in a transfer setting. Results indicate that improved posture in the transfer setting was functionally related to manipulation of training setting variables. Maintenance of posture gains in the transfer setting was excellent across a six-month follow-up phase.

Stimulus Control, Transfer and Maintenance of Upright Walking Posture with a Severely Retarded Adult

Advocates of applied behavior analysis have long emphasized that behavioral interventions should produce results with ecological as well as experimental significance (Baer, Wolf & Risley, 1968; Bandura, 1969). This suggests an intervention should be evaluated not only by its functional relationship with change in behavior, but by the overall importance of that change for the subject. Two concerns in such an evaluation will be: (a) the extent to which manipulation of variables in the intervention setting controls responding in other settings; and (b) the degree to which control is maintained over time.

Applied researches have typically focused on variables affecting stimulus control within a particular setting. A growing body of literature, however, suggests that control across settings, and over time is gaining increasing interest (Atthowe, 1973; Kazdin, 1973; Kazdin & Bootzin, 1972; Koegel & Rincover, 1977; O'Leary & Drabman, 1971). Rincover and Koegel (1975) have demonstrated that transfer of stimulus control is more likely when the stimuli controlling behavior in a training setting are also present in the transfer setting. The same auhors have also suggested that maintenance of responding in a transfer setting is improved if training stimuli and reinforcement schedules are difficult to discriminate from stimuli and reinforcement schedules in the transfer setting (Koegel & Rincover, 1977).

These data mesh well with experimental results indicating that transfer of a response from one stimulus to another will be more likely if: (a) the response is under stimulus control, and that control is not overly precise, i.e., the slope of the generalization gradiant is not extremely steep (Terrace, 1966); and (b) the training and transfer stimuli are similar along relevant dimensions (Guttman & Kalish, 1956; Jenkins & Harrison, 1960, 1962).

The ecological validity of applied behavior analysis rests largely on the ability of behavioral engineers to describe functional relationships between manipulation of training variables and control of behavior in non-training settings. The above research suggests that transfer of stimulus control will be promoted if an intervention brings appropriate responding under control of training stimuli that are the same, or similar to, stimuli found in transfer settings. In some cases this may involve first bringing responding under control of highly intrusive training stimuli and then transferring control to stimuli naturally occurring in both training and transfer settings.

The present study addresses this intervention model by assessing: (a) stimulus control of upright posture; (b) the effect of manipulating training stimuli on performance in a transfer setting; and (c) the extent to which improved performance in the transfer seting maintains over time. Within the context of this study "transfer" will refer to acquisition of stimulus control by one set of stimuli as a function of being paired with another set of stimuli which already controls the targeted response (Terrace, 1963b; Touchette, 1971).

Method

Subject

The subject was a 28 year old male diagnosed as profoundly retarded. His IQ on the Stanford Binet was 10. Four months prior to the study the subject was placed in a residential group home for the severely retarded, and began intensive vocational training at the Specialized Training Program, a contract assembly workshop for the severely and profoundly retarded at the University of Oregon. Prior to this placement he had spent 26 years in a state institution.

At the time of the study the subject exhibited very limited language skills, and walked with a pronounced forward lean. A medical checkup indicated his aberrant walking posture was not a function of physical abnormalities. In a two month program conducted prior to the study the subject received verbal praise for upright walking posture and was ignored when walking with poor posture. No change in the frequency of upright posture was noted during this program.

Settings

Data were collected in both training and transfer settings. The training setting consisted of a sidewalk and walkway forming the perimeter of a city block adjacent to the Specialized Training Program. Approximately 15 to 20 minutes were required to complete a walk on this route.

The transfer setting consisted of the route walked between the workshop and the residential group home. Due to a move of the group home there was a change in the transfer setting during the early phases of the study. The new route was very similar to the initial route in length, visual stimulation, and street crossing demands. The two transfer routes differed from the training route in that they (a) required crossing of a street; (b) required only 12 to 15 minutes to complete; (c) were conducted with a group home staff member; (d) ended at the group home instead of the workshop; and (e) were always conducted at the end of the work day while training walks occurred either in the morning or early afternoon.

Apparatus

Apparatus used in the study consisted of a transistor radio, a mercury switch, velcro, a vest, a baseball cap, and electrical wire. The mercury switch was wired to the on-off mechanism of the radio, and attached by the velcro to the baseball cap. The radio was worn in a pocket of the vest. When the subject wore the vest and cap, he was able to turn the radio on or off by manipulating the forward posture of his head. The radio was chosen as a likely reinforcer because of the subject's preference for listening to a radio in free operant situations.

Observation Procedures

Four graduate students in education served as obsevers. One or two observers assessed the subject's walking posture during each training or transfer walk. The observer(s) walked beside and slightly behind the subject, and carried a clipboard which emitted an auditory signal every five seconds. A binary coding system was used to score the subject's posture at the instant of each signal. A five second interval was scored "up" if the subject's head was oriented towards a point six meters or more in front of his feet. The interval was scored "down" if the subject's head was oriented less than six meters in front of him. This corresponded to a deviation in head angle of seven degrees or less from perpendicular being scored "up", and a deviation greater than seven degrees being scored "down".

A training walk consisted of 210 five-second intervals. Transfer walks averaged from 175 to 210 intervals depending on the speed at which the subject, and his fellow workers, walked home. Following each walk the percentage of intervals scored "up" was calculated and graphed. While data for training walks were taken every work day, transfer data were gathered only two to four times a week.

The topography of the subject's walking posture generally consisted of either good or extremely poor posture. The frequency of intermediate head angles was low. This facilitated accurate, reliable observation. Data were collected in both training and transfer settings throughout the study. Care was taken to minimize all social contact between the observer and the subject both during and after walks.

Observer Agreement

Observer agreement was assessed in each phase of the study for both training and transfer walks. Agreement data were obtained by two observers accompanying the subject on a walk. Simultaneous observations of the subject's posture were taken every five seconds.

Percent agreement between observers was used to determine observer agreement in both training and transfer walks. Agreement between observers was assessed for each five-second interval and the total number of agreements over agreements plus disagreements was calculated. The data collected by an observer were not included in the study until s/he met an agreement criterion of 95% over three consecutive days. One observer conducted reliability checks across all phases of the study.

Procedure

A single subject, multiple phase design was used to assess stimulus control, transfer of stimulus control, and maintenance of appropriate walking posture. Though data were collected in training and transfer settings throughout the study, manipulation of independent variables only occurred in the training setting.

A total of fourteen phases were evaluated. The first four of these were designed to demonstrate stimulus control of erect walking posture in the training setting. The next nine phases evaluated the degree to which erect posture in the transfer setting could be controlled by manipulating variables in the training setting. The final phase assessed the degree to which changes in posture maintained after training was terminated.

Procedures for the transfer walk were the same across all phases of the study. The subject walked from the workshop to the group home. He was accompanied by a group home staff member, two to five fellow residents, and an observer. No transfer setting variables were manipulated at any point in the study.

Procedures in the training walk, across the fourteen phases were as follows:

1) *Baseline (BL).* The subject wore all the apparatus during baseline, but the mercury switch was not attached to the radio controls. As such, the radio played at full volume throughout the walk regardless of the subject's posture.

2) *Subject Control₁ (SC_1).* During this phase the mercury switch was attached to the radio such that any forward lean causing a head orientation of less than six meters from the subject's feet would turn the radio off. During upright posture the radio played at full volume.

3) *Differential Reinforcement of Other (DRO).* In this phase placement of the mercury switch was exactly reversed. The radio would only play if the subject were leaning forward, and would shut off when the subject walked with appropriate posture.

4) *Subject Control₂ (SC_2).* This phase exactly replicated SC_1.

5) *Subject Control plus Two Walks (SC&TW).* Procedures in this phase were the same as in the SC phases, except that two training walks were conducted (one in the morning and one in the early afternoon).

6) *Subject Control plus Two Peers₁ ($SC\&TP_1$).* The subject continued to go on two training walks a day. In this phase, however, two fellow workers who were randomly selected each day accompanied him on each training walk.

7) *Experimenter Control₁(EC_1).* During this phase procedures were the same as in $SC\&TP_1$, except that the observer wore the vest and radio with the mercury switch attached to the clipboard. The radio could be turned on or off by tilting the clipboard. The observer turned the radio on when the subject's head was "up", and turned it off when the subject's head was "down". The subject did not wear any apparatus.

8) *Subject Control plus Two Peers₂($SC\&TP_2$).* This phase returned to procedures in $SC\&TP_1$. The subject again wore the apparatus.

9) *Experimenter Control₂ (EC_2).* This phase replicated EC_1. The experimenter wore, and controlled the apparatus.

10) *Radio Fading (RF).* In this phase the experimenter continued to wear the apparatus. Radio volume, however, was systematically reduced. Five evenly spaced points on the volume control of the radio were marked off. The points ranged from full volume to a level identified as "just audible" by two observers. Volume was faded out across five periods: (a) during the first seven days of RF the volume level was one point below full volume, (b) during the next four days training walks were conducted with the volume reduced one more point, (c) during the next seven days the volume was lowered an additional point; (d) for the next four days the radio volume was at the "just audible" level, and (e) the final seven days of this phase were conducted with the observer continuing to wear the apparatus, but the radio was never turned on.

11) *No Apparatus₁ (NA_1).* During this phase no apparatus was worn by either the subject or the experimenter. The training walks during this phase were very similar to the transfer walks.

12) *Subject Control plus Two Peers₃ ($SC\&TP_3$).* This phase replicated previous SC&TP procedures. The subject once again wore the apparatus and the radio was set at full volume.

13) *No Apparatus₂ (NA_2).* This phase replicated NA_1.

14) *Follow-Up (FU).* During this phase the subject did not go on training walks. Data from the transfer setting were collected once a week for seven weeks. Five months after training had been terminated, observation during two final transfer walks was made.

Results

During the fourteen phases of the study observer agreement was measured 55 times in the training setting and 29 times in the transfer setting. As shown in Figure 1 agreement was assessed in all phases of the study. Observer agree-

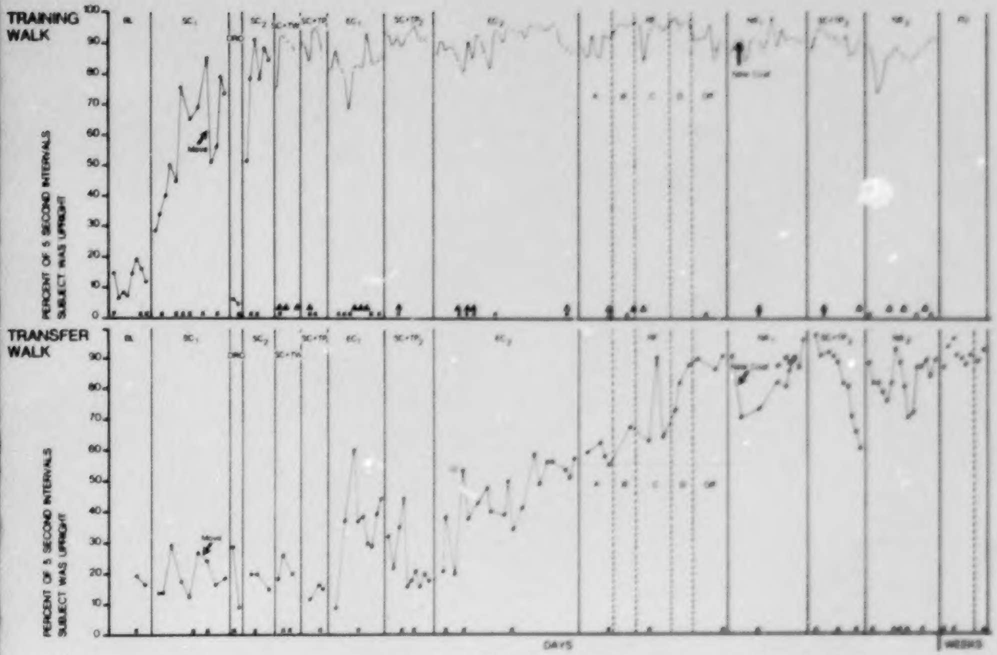

FIGURE 1

The percent of upright posture in training and transfer settings across days.

Xs indicate days when reliability data were taken on initial walks.
Triangles indicate when reliability was taken on the second training walk.
Open circles represent the daily average of the two training walks.
Asterisks indicate rescoring of data where intervals in which the subject was looking at his coat were discarded.

ment averaged 95% in the training setting with a range from 79% to 99%. Agreement in the transfer setting averaged 96% with a range between 86% and 100%.

Figure 1 indicates the percent of five-second intervals scored "up" during the training and transfer walks across the study's fourteen phases. The phases can be divided into three main sections. The three sections provide data on stimulus control, transfer of control and maintenance of stimulus control.

Stimulus Control

The first four phases of the study make up section one. These phases comprise an ABCB experimental design, sufficient for determining (a) if improved upright posture was functionally related to intervention procedures, and (b) if the intervention procedures were functionally related to performance change in the transfer setting.

The eight days of BL data from the training walk indicate upright posture was performed at an infrequent, though stable, rate. During SC_1, however, music on the radio became contingent on upright posture, and a substantial increase in upright walking was observed. The first walk in this phase terminated early when the subject dismantled the apparatus. Data from this aborted walk are not reported.

On the ninth day of SC_1 all members of the group home moved to a new residence. Following this move a short-lived decrease in upright posture occurred. Lack of experimental control prevents any discussion of a functional relationship between the move and reduction of erect posture on training walks. Of major note in the SC_1 phase is that appropriate walking posture during the last eight days of the phase was recorded an average of 70% of the training walk intervals. This is almost a six-fold improvement over the eight days of BL.

Following implementation of the DRO procedures the lowest levels of upright posture throughout all phases of the study were observed. The subject dropped from 73% of the training intervals scored upright on the last day of SC_1 to 5% and 4% on the two days of DRO. This effect was dramatically reversed in the SC_2 phase. The subject was observed with upright posture 84% of the intervals during the last five days of SC_2. The reversal effect observed across the SC_1, DRO and SC_2 phases strongly suggests that stimuli provided by the apparatus were controlling walking posture.

The immediate and dramatic slope and level changes across the first four phases of the study indicate that contingent access to music on the radio was sufficient to control upright walking posture. Data from the transfer walk, however, show that training setting gains did not generalize to the transfer setting. In fact on several days during both SC phases the subject's rate of upright posture in the training setting was over three times that observed in the transfer setting.

As shown in Figure 1, upright posture in the transfer setting remained within a stable range of 9% to 29% across the first four phases. This closely resembles the rate of upright posture noted in the training setting during BL.

Transfer of Stimulus Control

The second section of the study included phases five through thirteen. These were designed to determine if manipulation of training setting variables could both maintain upright posture in the training setting and gain control of responding in the transfer setting.

In the SC&TW phase the subject went on two training walks per day. Due to the similarity of data collected on the two training walks, results are reported as the daily mean of these two walks. There was no change in performance in either the training or transfer phases during the five days of SC&TW.

The next four phases of the study (SC&TP$_1$, EC$_1$, SC&TP$_2$ and EC$_2$) serve as an ABAB experimental design. The major dependent measure across this design was the rate of upright posture in the transfer setting. As can be seen in Figure 1, performance remained stable in both settings when two peers began accompanying the subject on training walks (phase SC&TP$_1$). When the experimenter wore the apparatus (EC$_1$), however, there was a slight loss of control in the training setting and a doubling in the rate of upright posture in the transfer setting.

It is important to note that the loss of control in the training setting and improved performance in the transfer setting were paired not only with removal of the tactile stimuli provided by the apparatus, but by two other subtle changes. First, during the EC$_1$ phase the on-off control of the radio was manipulated by the observer. As a result, the latency between change in head posture and change in access to music was slightly longer in the EC$_1$ phase than in previous phases. A second change was the physical proximity of the subject to the radio. During the initial phases of the study the radio was in the breast pocket of a vest the subject wore. During EC$_1$ the vest and radio were worn by the observer, hence, the radio was approximately four to five feet further away from the subject, and it is assumed some loss of volume was perceptible. The present design does not allow effects from each of these manipulations to be assessed independently.

When the subject once again wore the apparatus in the SC&TP$_2$ phase there was an immediate increase and stabilization of upright walking posture in the training setting. A decrease in performance, however, was observed in the transfer setting. During the last six days of SC&TP$_2$ the subject walked with upright posture an average of only 18% of the time.

Implementation of the EC$_2$ phase was followed by an initial, slight decrease in level and an increase in variability of upright training posture. Soon, however, training data indicated consistent, stable, rates of upright performance. Transfer performance gradually improved and then stabilized during EC$_2$. Data from the last seven days in the transfer setting fell within a range of nine percentage points. This low level of variability was felt to indicate stability of performance. If the transfer data for the EC$_2$ phase alone is assessed this stability criterion appears reasonable. When the same data is viewed within the context of SC&TP$_2$, EC$_2$ and RF data, however, the overall upward trend of the data suggests this arbitrary stability criterion may have been insufficient.

Transfer data across phases SC&TP$_1$, EC$_1$ SC&TP$_2$ and EC$_2$ indicates evidence of an ABAB reversal effect. Change in subject performance in the transfer setting systematically followed manipulation of training variables. This suggests that stimulus changes associated with having the observer, rather than the subject, wear and manipulate the apparatus, were in fact functionally related to performance in the transfer setting.

Data from the RF phase show highly stable rates of upright posture in the training setting, and progressively improving rates of upright posture in the transfer setting. The last four days of transfer data averaged 87%. This is nearly equal to the rate of upright posture observed on training walks. The systematic fading of radio volume in the RF phase fits the model of a changing criterion design (Hartmann & Hall, 1976). There is insufficient transfer data, however, to assess the RF phase using a changing criterion analysis. In addition, the data that were collected do not follow the pattern predicted by that design. As such, this phase of the study lacks experimental control.

While the NA_1, $SC\&TP_3$ and NA_2 phases are clearly not independent of preceeding manipulations, they can be viewed from the perspective of a BAB experimental design. In the seventeen days of the NA_1 phase the subject maintained a high rate of upright posture during training walks even though the radio apparatus was not present. As can be seen in Figure 1 a substantial drop in the level of upright posture in the transfer setting followed implementation of the NA_1 phase.

On the second day of NA_1 the subject received a new coat. The coat was always worn during transfer walks, but only worn occasionally during training walks. Observers reported that the majority of transfer intervals scored "down" on the first two transfer walks after the coat was purchased were due to the subject orienting toward, and manipulating the pockets of his coat. To avoid this potential confound, data for the next four transfer walks are presented both with intervals when the subject was orienting toward pockets scored as "down", and with those intervals discarded. The decreasing discrepancy between these two methods of scoring suggests that data for the NA_1 phase may have been less variable had the subject not received a new coat.

The last six days of the NA_1 phase demonstrate substantial stimulus control of upright posture in both settings. When $SC\&TP_3$ procedures were implemented training setting data did not alter. A marked change in slope can be seen, however, in data from the transfer setting. During the ten days of this phase upright posture dropped in near linear fashion from 97% to 59%. This suggests a substantial loss of stimulus control by those stimuli which had come to control upright posture in the transfer setting. A return to NA conditions in the NA_2 phase was followed by a return to high rates of upright posture on the transfer walk. During the last five days of NA_2 an average of 86% of the intervals were scored "up" within a range of only five percentage points.

The reversal effect noted across the NA_1, $SC\&TP_3$, and NA_2 phases again indicates that manipulation of training setting variables was functionally related to performance during transfer walks. Upright posture in the NA_1 phase was controlled by non-apparatus related stimuli in both training and transfer settings. Presentation of the apparatus, however, appeared to have a debilitating effect on this control during transfer walks. It is unclear what effect presentation of the apparatus related stimuli had on the control exerted by non-apparatus related stimuli in the training setting.

Maintenance

The final section of the study contained only the FU phase. This phase evaluated maintenance of improved posture in the transfer setting after training walks were terminated. Figure 1 presents data collected at weekly intervals over the seven weeks after training ended. In addition data from two final walks were collected at 21 and 22 weeks respectively after training walks had been terminated. Results from these walks indicate the subject maintained his high rate of upright posture at a level equal to or better than that observed during the previous NA_1 and NA_2 phases. These data are impressive given that no social or edible rewards were contingently delivered for upright posture, and no "booster" training sessions were run.

Discussion

One determinant of the control a stimulus will exert over a response is the extent to which that stimulus sets the occasion for a contingent relationship between the response and a consequence (Skinner, 1969)[1]. It is likely that those training setting stimuli in the present study, which set the occasion for a contingent relationship between upright posture and music from the radio, came to control upright walking during the early phases of the study. That this control was not initially exhibited in the transfer setting suggests either: (a) an initial increase in upright posture occurred outside the training setting but was extinguished (Koegel & Rincover, 1977), or (b) the stimuli controlling upright posture in the training setting were not present in the transfer setting (Rincover & Koegel, 1975).

Training data from the SC_1, DRO and SC_2 phases indicate the subject's initial upright, training posture was controlled by stimuli provided by the apparatus. It is likely the poor rate of upright posture observed in the transfer setting during SC_1 and SC_2 phases was functionally related to the absence of these controlling stimuli. To facilitate upright posture in the transfer setting an attempt was made to transfer control to stimuli present in both training and transfer settings. Numerous studies suggest that a response controlled by one set of stimuli can be brought under control of a new set of stimuli by presenting both the new and original stimuli simultaneously, and then gradually fading the originals (Fields, Bruno, & Keller, 1976; Sidman & Stoddard, 1967; Terrace, 1963 a, b; Touchette, 1971; Westbrook & Miles, 1970). In the present study it was felt the proprioceptive, visual and/or tactual stimuli naturally present in both settings could control upright walking if stimuli provided by the apparatus were faded out.

The EC_1 phase marks the first manipulation in which some stimuli provided by the apparatus were removed. Transfer data from the EC_1 phase indicate a marked improvement in posture over the low rates observed in the previous six phases. As noted earlier this effect may have been related to latency or proximity changes in the contingent delivery of music. It is also likely, however, that the tactile stimuli provided by the apparatus had come to partially control upright posture. Removal of the tactile stimuli may have served to partially fade controlling stimuli provided by the apparatus and facilitate transfer of some control to new stimuli naturally present in both training and transfer settings. If the new stimuli came to partially control upright walking in the training setting, and if these stimuli were also present in the transfer setting, partial control of upright posture in the transfer setting would be expected.

Evidence of a ABAB reversal effect observed across the $SC\&TP_1$, EC_1 $SC\&TP_2$ and EC_2 phases indicates that the increase in upright posture in the transfer setting during EC phases was functionally related to whether the subject or the observer wore the apparatus. Though posture in the transfer settings improved during the EC phases, it remained half that observed in the training setting. This suggests that transfer setting stimuli only partially controlled upright walking at this phase in the study. Not until the auditory stimuli provided by the radio were faded out in the RF phase did transfer setting stimuli come to control responding at the same level as training setting stimuli. It is possible the auditory stimuli from the radio exerted substantial control over upright walking. This control may have limited the transfer of control to new stimuli. The present design does not, however, provide sufficient experimental control to evaluate this possibility.

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[1] Recent operant research requires at least a footnote be added in recognition of the non-trivial role classical conditioning may play in the acquisition of stimulus control (Schwartz & Gamzu, 1977).

Recent research suggests that transfer of stimulus control during fading is a gradual process (Ray & Sidman, 1970; Sutherland & Mackintosh, 1971). As the stimuli controlling a response are faded, both new stimuli and the partially faded original stimuli exert control. When the original stimuli are completely faded the new stimuli alone control responding (Fields, Bruno, & Keller, 1976). The partial control of upright posture during EC phases may well reflect the early stages in this model of transfer. Responding in the training setting may have been controlled by both the auditory stimuli provided by the apparatus, and other stimuli natural to the setting. If some of these new controlling stimuli were also present in the transfer setting, improved posture in the transfer setting would be expected.

In the last part of the RF phase and the two NA phases, the subject exhibited nearly equal rates of upright walking in the two settings. This high rate of responding occurred even though the stimuli which had controlled upright posture in the early phases of the study were not present in either setting. These data argue that control of upright posture in the training setting had transferred from apparatus-specific stimuli to some other set of stimuli present in both training and transfer settings. This would be consistent with operant research on stimulus blocking. Research examining the effects of blocking indicates that previous discrimination training with one stimulus from a group of simultaneously presented stimuli will reduce the control acquired by other stimuli in the group (Fields, Bruno, & Keller, 1976; Rescorla & Wagner, 1972). The conditioning of upright posture to apparatus-specific stimuli during the initial phases of the study may have been functionally related to the limited acquisition of control by other stimuli during fading.

Blocking has generally been discussed only with reference to acquisition of stimulus control by new elements of a compound stimulus. A similar process, however, may have also affected performance in the SC&TP_2 and SC&TP_3 phases. During these phases, stimuli previously controlling responding in the transfer setting appeared to lose that control, even though stimulus manipulations only occurred in the training setting. The addition of apparatus-specific stimuli may have not only functioned to prevent new stimuli from acquiring control, but actually reduced the control that had already transferred. Further analysis of this phenomenon is necessary.

The present study demonstrates that a profoundly retarded adult was able to gain control of behavior as complex, and seemingly involuntary, as walking posture. Of additional significance is the demonstartion that the subject's improved performance transferred to a setting where training never occurred, and maintained over a substantial time period. While no attempt was made to systematically identify variables affecting maintenance, it is possible there were events other than music which came to function as reinforcers for upright posture.

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Workshop Supervision: Evaluation of a Procedure for Production Management with the Severely Retarded

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Abstract

Work rates of three severely retarded adults assembling a cable harness were studied over an 18-month period. Supervision contingencies involving differential reinforcement of higher production rates resulted in increases in production rate and decreases in variability in comparison with ongoing supervision procedures that involved partial immediate payment (token reinforcement) for work, contingent supervisor contact for task appropriate work behavior and immediate quality control. The degree of improvement of two of the three subjects was considered ecologically significant on the basis of productivity levels reached and maintenance of those levels.

Workshop Supervision: Evaluation of a Procedure for Production Management with the Severely Retarded

The ability of adults labeled severely and profoundly retarded to learn remunerative vocational skills has been demonstrated periodically for two decades (Bellamy, Peterson, & Close, 1975; Clarke & Hermelin, 1955; Crosson, 1969; Gold, 1976; Jacobs, 1976; Karan, Wehman, Renzaglia, & Schutz, Note 1), Impressive as these demonstrations of learning are, they still provide an incomplete foundation for vocational habilitation of the more severely handicapped. After skills have been learned, the rate at which they are performed has much to do with vocational success. For example, work rate has typically affected individual access to vocational programs, remuneration in these programs, and the opportunity to progress from sheltered programs to more competitive work situations (Federal Register, 1974). Further, in spite of social service funding, the economic viability of many sheltered vocational programs depends on each worker reaching a productivity level that generates nontrivial overhead income for the program.

Research on increasing the productivity of severely retarded individuals has been sparse, no doubt reflecting their relative absence in existing vocational programs. Reviews of the available research are consistent in concluding that different supervision methods can have quite different effects on worker productivity (Bellamy, Inman, & Schwarz, in press; Gold, 1973). Successful supervision techniques have included a variety of procedures, such as using planned contingencies of positive reinforcement for work behaviors (Schroeder, 1972; Zimmerman, Stuckey, Garlick, & Miller, 1969), providing systematic consequences for work-related behaviors like task attending and accuracy (Bellamy, Peterson, & Close, 1975; Rusch, Connis, & Sowers, Note 2), and developing stimulus control over work behaviors by using and fading mechanical cueing systems (Martin & Flexer, Note 3).

The ecological significance (Brooks & Baumeister, 1977) and the utilization of research on work rate in vocational settings appear limited by two important differences between typical research and service settings. First, the time frame of research projects often differs substantially from that of vocational programs. From a practical standpoint, after vocational skills are taught their utility depends in large measure on the extent to which adequate work rate is maintained for extended periods of time. To date, little research has addressed this issue. Much of the published work on production supervision has reported performance during relatively short employment periods, while community vocational programs are necessarily concerned with performance during several months or years. This distinction attains considerable importance when the possibility of performance changes over time is considered; the long range effects of specific supervision procedures may differ from their immediate impact (Loos & Tizard, 1955).

A second typical difference between many research and service settings which may impede practical application of research results is the reliance in many studies on equipment or personnel resources which are not usually available to practitioners. Automation of procedures for measuring productivity (Schroeder, 1972), cueing workers as to expected behavior (Screven, Straka, & LaFond, 1971) and managing contingencies (Greene & Hoats, 1969) have done much to illustrate the potential impact of various supervision approaches. However, these procedures often cannot be replicated in programs with limited staff and equipment budgets. Applied programs are then left with the task of devising less expensive methods to duplicate published results, a task which may be as difficult as conducting the original research.

These potential impediments to the practical application of research results motivated the research program from which this report derived. A need was apparent for study of the effectiveness of practical supervision methods during reasonably long employment periods. The purpose of this paper is to describe the work rates of three severely retarded adults during time periods of several months and to assess the effectiveness of a set of supervision procedures using a multiple baseline measurement strategy.

Method

Subjects

Production data are presented for three women employees of the Specialized Training Program, a community workshop for severely and profoundly retarded adults at the University of Oregon. They ranged in age from 19 to 26 years, in MA (Stanford-Binet) from 2.6 to 3.2 years and had been community residents for approximately 10 months after being institutionalized most of their lives. Previous vocational experience was quite limited for all three subjects, involving sorting and folding of laundry and bed-making tasks. These are the same three workers whose acquisition of a cable harness task was described by Hunter and Bellamy (1976).

The Work Task

Each subject was assigned the job of constructing a cable harness which contained eleven color-coded wires. Construction involved threading the wires in sequence on a plywood board, which was marked with a channel where wires were placed according to cues for beginning and termination points for each wire. A continuous elastic cord was then used to tie the cable with approximately 75 self-tightening knots. Schematic illustrations of the cable and the knots are provided in the Hunter and Bellamy (1976) report. The cable harness was subcontracted from Tektronix, Incorporated, for an amount based on the normal production standard of 17 minutes. While producing the task, each subject sat at an individual workbench which held materials required for assembly, a data sheet for recording production information, and a kitchen timer, which was used during intervention phases.

The Work Setting

Work was performed during six-hour days, with four and one-half hours of actual production time. The production area was a single room of 802 square feet, equipped with individual tables or work benches and a variety of hand tools. Workers in the program entered this production area only after they had learned to complete assigned tasks without assistance. To accomplish this, individual training was conducted in a separate area using procedures described by Bellamy, Inman, and Schwarz (in press) and Hunter and Bellamy (1976).

In the production room two supervisors were responsible for 14 workers, each of whom worked independently on an assigned task. Supervisors were either professional staff members or university students, and they were responsible for (a) insuring that each social contact with a worker occurred as a contingent consequence of task-appropriate work behavior, (b) conducting quality checks of all products when they were completed by a worker; (c) providing a partial immediate payment in cash for error-free products; (d) managing a small store in which this partial payment could be exchanged for a variety of edibles during breaks; and (e) maintaining production data.

Data on production rates of all workers were recorded continuously by the supervisors. As soon as a worker completed a task or set number of tasks, the supervisor recorded the time the assembly was completed, the time the next assembly was begun, the number of units completed and the amount paid to the worker. Elapse time in production was thus continuously divided into intervals which were defined by these start and stop times and associated with a specific number of tasks completed. Reliability of these production records was assessed during 90-minute work periods at intervals of approximately six weeks for one year. An observer recorded start and/or stop times for each worker in a one-way observation area, typically without the knowledge of supervisors responsible for data collection. Reliability, computed by dividing the number of recorded times which differed less than one minute with the total number of times recorded in each work period, ranged from 85 to 100 percent and averaged 95 percent.

Within this overall supervision system, individualized supervision contingencies were provided by systematic variation in the amount and nature of supervisor contact in production, the number of products or amount of time between the supervisor's quality checks, the amount and schedule of partial immediate payment, the time delay between payment and exchange, and the contingency relationships between the workers' behavior and either social contact or payment. The present example of this individualization focused on the contingency relationship between work production and partial immediate payment.

Procedure

A multiple baseline design across three subjects was used to measure the effects of a timer contingency which differentially reinforced higher production rates. During baseline, the following conditions were in effect: When a subject finished a task, she raised a hand to signal a supervisor. The supervisor then conducted a brief quality check of the completed cable and, if it was constructed correctly, delivered one penny to the subject. Then the supervisor recorded the stop time, units completed, amount paid to the subject, and the start time for the next cable. The few incorrect cables were disassembled to the point where an error had been committed, and the subject was again allowed to complete the task independently. As in all production situations in the program, supervisors periodically provided supportive verbal or physical contacts with subjects as a consequence of on-task behavior. For Subject 2, an immediate-store contingency was added to the original baseline conditions approximately four weeks after baseline had begun. Under this condition, she was allowed to spend her partial payment immediately after earning it. This was done in an attempt to increase the effectiveness of the token reinforcer.

When the timer contingency was first imposed for each subject, the supervisor informed her that if she completed her cable before the timer bell sounded, she would receive two pennies for the completed unit instead of the usual one. The timer was then set for the average time required by that subject to complete a cable over the previous five days. If a subject finished an assembly before the timer bell sounded, she raised her hand as a signal to the supervisor who then performed a quality check, praised the subject for completing the work before the bell sounded, gave her two pennies and allowed her to turn off the timer. The supervisor then recorded the production data as described above. The timer was reset and the contingency restated. If a subject failed to beat the timer, the procedure was the same except that only one penny was delivered upon task completion. For Subject 2, the immediate store contingency remained in effect for the first eleven weeks of the intervention.

Results

Figure 1 represents mean cable-assembly time per day for the three subjects. Visual inspection reveals a clear A B effect for two subjects. There is a definite and sustained reduction both in task completion time and in day-to-day variation as a function of imposing the timer contingency. The results for Subject 2 are less clear.

Subject 1 was exposed to baseline conditions for five weeks during which production time varied considerably from day-to-day (range 25 to 60 minutes) with no obvious trend over the last two weeks (see Figure 1). When the timer contingency was imposed there was an immediate reduction in day-to-day variation and a steady reduction in production time over a period of six weeks. During the following three weeks production time increased slightly but day-to-day variation remained minimal. Table 1 shows cable-to-cable variation three weeks before and after intervention. Prior to intervention, mean cable assembly time was 39.8 minutes, well over the industrial time standard of 17 minutes. After intervention, mean assembly time during the first three weeks was 26.3 minutes, and this continued to drop until the behavior became stable at 20.5 minutes per cable. The standard deviation of cable completion times during the three weeks prior to intervention was 11.76 minutes per cable. After intervention, the standard deviation dropped to 4.7 minutes per cable. Follow-up data taken after 2 weeks of doing other work demonstrated that the effects were still evident when the subject again performed the cable harness assembly with the timer contingency in effect.

Subject 2 also experienced five weeks of baseline. Under this condition (see Figure 1) day-to-day change in production time was extremely variable. Mean cable assembly time was 150 minutes per cable. When the immediate-store contingency was implemented there was a marked reduction in day-to-day variation, though production time was still far above the industrial time standard. Table 1 shows that mean cable assembly time during the last three weeks

TABLE 1

Summary data for three subjects reflecting mean cable-assembly time, standard deviation and range during the last three weeks of baseline and the first three weeks of the timer contingency.

	Baseline			Timer Intervention		
	Mean (Minutes)	Standard Deviation	Range (Minutes)	Mean (Minutes)	Standard Deviation	Range (Minutes)
Subject 1	39.8	11.76	50	26.3	4.70	24
Subject 2	75.0	19.45	87	65.3	16.9	93
Subject 3	27.9	6.65	40	19.9	3.06	16

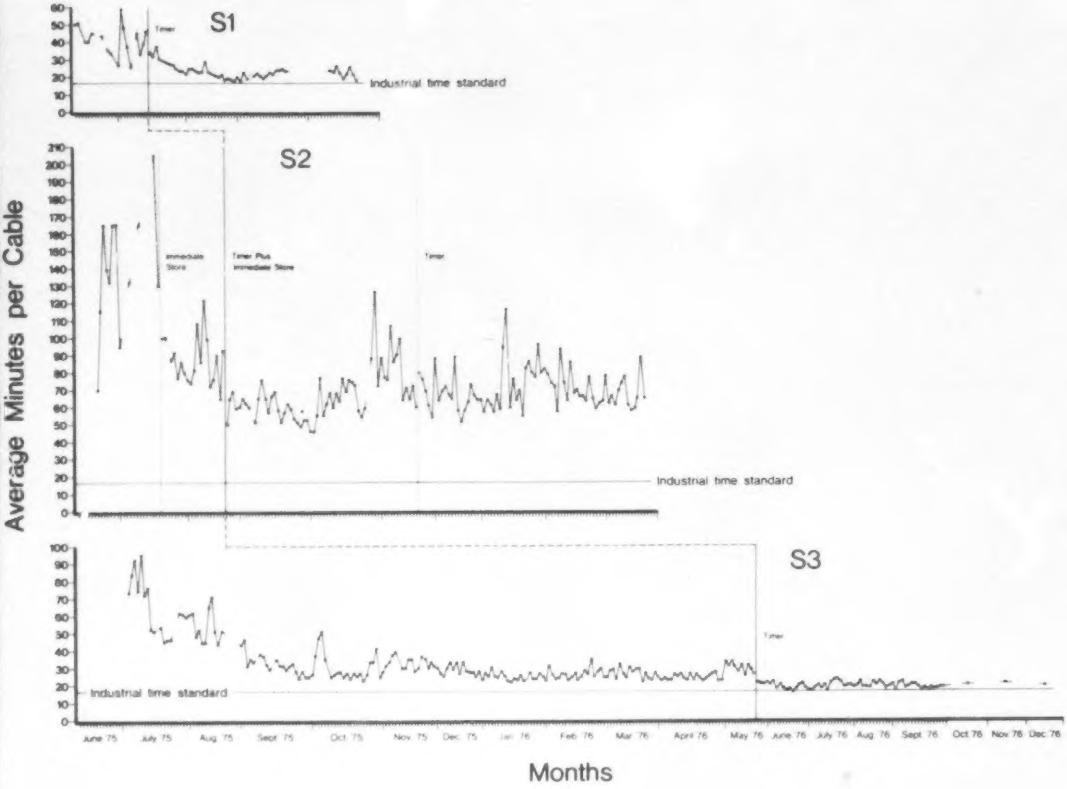

FIGURE I

Average number of minutes required each day by the three subjects to construct an eleven-wire cable harness under baseline, immediate store and timer contingency.

of this contingency was 75 minutes per cable. It is significant that during the immediate-store contingency the criterion level for stability was five days of stable behavior. This being the case, the contingency was modified after five weeks in spite of a general trend downward (see Figure 1). The decision to add the timer contingency was also precipitated by the fact that production time was still 63 minutes above the industrial time standard.

When the timer contingency was implemented there was a significant drop in production time. Table 1 indicates that mean production time three weeks prior to the timer contingency was 75 minutes per cable, and that after intervention production time dropped to 65.3 minutes per cable. In addition, there was a reduction in the standard deviation of cable assembly times from 19.45 minutes per cable to 16.9 minutes per cable. Figure 1 shows these effects lasted for about six weeks. During this time there was no indication of continued improvement, as there had been for Subject 1. For unknown reasons at six and one-half weeks both production time and day-to-day variation began to increase. Evidently, the contingencies and/or the tokens themselves began to lose their capacity to control the subject's work behavior. At the end of 12½ weeks the immediate store contingency was terminated due to the staff time and effort required to maintain the contingency system. No significant change occurred as a function of this final manipulation. Production time remained below baseline levels but was relatively variable and at least 55 minutes above the industrial time standard over a period of 14 weeks.

For Subject 3 baseline conditions lasted approximately 35 weeks. Figure 1 shows there was a steady reduction in production time over the first 12 weeks which may be related to the contingencies in effect in the entire production setting and to practice. The behavior then stabilized and remained as such for approximately 23 weeks. Table 1 indicates that mean production time and standard deviation three weeks prior to intervention was 27.9 and 6.65 minutes per cable respectively. When the timer contingency was imposed, there was an immediate reduction in cable-to-cable variation and a reduction in mean production time. During the first three weeks of intervention, mean assembly time per cable was 19.9 minutes and standard deviation of assembly time was 30.06 minutes. This put the worker's production rate very near the industrial time standard. Moreover, the effect lasted in excess of six months, as revealed by monthly averages presented in Figure 1.

Discussion

There are several interesting aspects of these data which deserve attention. First, to be practical, a supervision procedure must be inexpensive and effective in maximizing individual productivity for extended periods of time. The potential conflict among these needs is apparent. Individualization of contingencies in production is frequently needed to increase productivity, while standardization of production contingencies may be necessary to reduce staff costs. The supervision procedure described in this report was an effort to meet both needs. Data collection procedures, reinforcement type, and work arrangement were standardized for all workers, while reinforcement magnitude and contingencies were varied individually. In comparison with standardized supervision procedures alone, this combination of standarized and individualized contingencies improved the work rates and decreased the variability of all three workers.

However, inspection of Figure 1 indicates there was considerable variation in the effectiveness of the the timer contingency. For subjects 1 and 3 there was a clearly significant reduction in production time as a function of imposing the timer contingency. This is indicated since (a) the degree of reduction was significant, i.e., production time closely approximated the industrial time standard, and (b) the time periods over which the contingencies had an effect were sufficiently long to be of vocational importance. Taken together, these effects support the ecological significance of the results obtained. That is, the behavior change which resulted from the supervision procedures allowed the workers to perform competently in this structured vocational setting.

For Subject 2 the advent of the timer contingency did not produce ecologically significant changes. Although average production time decreased by approximately ten minutes immediately after intervention, the resulting rate was still far removed from the industrial standard on which wages and shop earnings were based. Further, the duration of the behavior change was too short to meet normal job requirements for dependability in this and other work settings. The subject's performance was marked by long periods in which she attended to stimuli other than the work task, by slow deliberate movements during assembly, and by brief pauses throughout each assembly sequence.

To produce extended work performance at normal rates, a supervisor can manipulate any of a constellation of variables relating to the organization of the work setting, consequences for task attending, consequences for task comcompletion, and the contingencies which determine delivery of these consequences. The research tasks at hand are to identify those combinations of supervisor variables which result in more rapid movements, more complete stimulus control within the work setting, (so that the task sets the occasion for appropriate assembly behaviors), and more complete stimulus control within the task itself, (so that errors, pauses, and irrelevant behaviors are reduced).

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Evaluation of a Procedure for Teaching Saw Chain Assembly to a Severely Retarded Woman

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Abstract

Although several demonstrations are available that severely retarded persons can learn difficult vocational tasks, little effort has been made to determine whether this learning occurs as a result of the reported training procedures. Therefore, the purpose of this research was to determine whether a functional relationship existed between specific training procedures and task acquisition. A severely retarded woman learned to assemble saw chain when teaching procedures involving differential reinforcement, modeling, and physical priming were used. The use of a multiple baseline design across task segments allowed for the interpretation that the procedures were functionally related to the trainee's gains. The results support previous illustrations of the potential vocational competence of severely retarded persons and imply that applied researchers should now focus on reducing the discrepancy between research results and existing service programs. One promising area of applied research suggested in the results is the study of generalized skills or operations in vocational training.

Evaluation of a Procedure for Teaching Saw Chain Assembly to a Severely Retarded Woman

Acquisition and performance of vocational tasks by severely and profoundly retarded persons have been reported with increasing frequency during the last two decades. It now seems clear that to label a person "retarded," even "severely retarded," implies no necessary restriction on the individual's potential to learn a variety of work behaviors (Bellamy, Peterson, & Close, 1975; Clarke & Hermelin, 1955; Crosson, 1967; Gold, 1976; Hunter & Bellamy, 1976; Karen, Eisner, & Endres, 1974; Martin & Flexer, Note 1).

The demonstrational emphasis of much of this literature motivated the present research. Acquisition of vocational skills by severely retarded adults has been reported often, but little effort has been made to determine whether those gains are actually the results of reported teaching procedures. For example, none of the studies cited utilized experimental designs which rule out the possibility that learning resulted simply from extended exposure to the task or trainer. Therefore, the purpose of this research was to ask if the learning of a difficult vocational task was functionally related to the defined training procedures. Specifically, a case study in vocational training will be presented to illustrate the ability of a severely retarded woman to learn to assemble saw chain, a task potentially available to sheltered workshops. In the study the relationship between training procedures and task acquisition was assessed in a multiple baseline design across task segments.

Method

Trainee

The trainee was a 30-year old woman labeled either severely or profoundly retarded on the basis of several standardized intelligence tests administered over the last 10 years. At the time of the research she had been a participant in a community vocational training program for fourteen months. Prior to that, the trainee had resided in a state institution for nine years with neither vocational nor educational programming. She had no functional expressive language, but followed some simple verbal directions and imitated some movements.

The Work Task

The task involved assembly of 11 small parts to form a repeating segment of saw chain, the cutting portion of chain saw blades (see Figure 1). Each of the components measured approximately 1.5 cm x .5 cm. Assembly involved stacking the components in three levels, with each piece requiring correct rotation on both horizontal and vertical axes. Stacking was done on a masonite strip with grooves which held the bottom set of components in a straight line. Assembly of the product involved performing, in sequence, a chain of behaviors which was defined in 47 steps, or discriminated operants. At the completion of training the subject was expected to complete the task without assistance. This involved moving a place marker in front of each parts bin in turn, picking up a component from the bin and placing it correctly on the chain assembly.

Training Materials

In addition to the task itself, training involved the use of a parts bin apparatus, in which parts were stored separately in the order of assembly. The apparatus consisted of a row of 11 3-inch (7.6 cm.) square compartments. In front of each compartment was a small platform on which the trainee moved a wooden block to mark her place in the assembly. Small edibles and later pennies, which could be exchanged for edibles, were delivered contingent upon task-related behaviors during training.

A data sheet adapted from that described by Saunders and Koplik (1975) was used to record correctly completed steps during non-reinforced probe trials. On the data sheet the 47 steps were listed sequentially and divided into three segments containing 17, 16 and 14 steps respectively. Each step was defined by describing both the task cue, which provided the natural discriminative stimulus for the required behavior, and the behavior itself. Rows of numerals opposite each step were used both to record responses to individual steps and to maintain a frequency polygon of the total number of steps completed correctly in each of the three segments (see Figure 2).

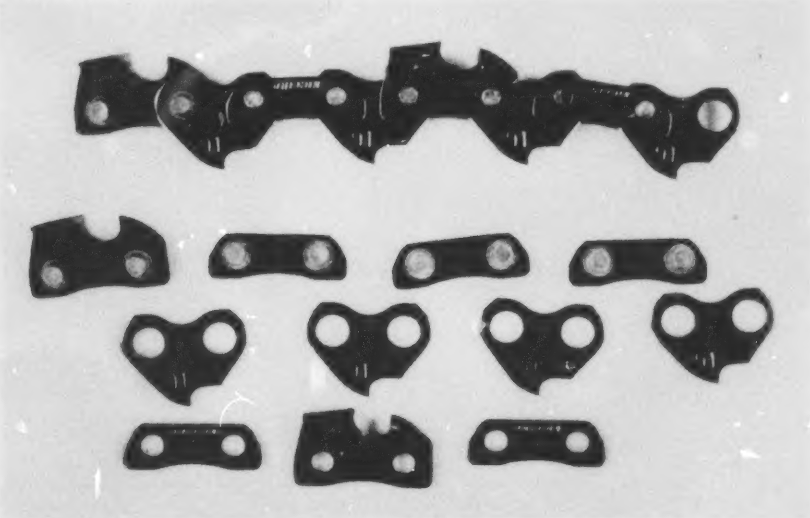

FIGURE 1

Illustration of the saw chain assembly task.

Data Collection

Correct responses for each discriminated operant in the task were recorded during probes which occurred after every 20 minutes of training. During probes the trainee responded to the discriminative stimulus defined for each step in the task. This was accomplished by letting her continue without interruption when a step was completed correctly and by having the trainer complete the step after incorrect responses (thereby creating the discriminative stimulus for the next step). During probe trials the trainer made comments like, "You are really trying hard," etc., while the trainee was manipulating task components, regardless of whether responses were correct.

A response was scored as correct if the trainee responded to the discrimina-

SEGMENT 3	14. Chain at end of board–move marker off left side	14	14	14	14	14	14	14	14
	13. K in place–pull chain to left end of board	13	13	13	13	13	13	13	13
	12. K rotated–place on C studs	12	12	12	12	12	12	12	12
	11. K in hand–rotate *Oregon* up and curved edge away	11	11	11	11	11	11	11	11
	10. Marker in place–reach for 11th bin and pull out K	10	10	10	10	10	10	10	10
	9. J in place–move marker to 11th bin	9	9	9	9	9	9	9	9
	8. J rotated–place over B studs	8	8	8	8	8	8	8	8
	7. J in hand–rotate hook down and curved edge away	7	7	7	7	7	7	7	7
	6. Marker moved–reach for 10th bin and pull out J	6	6	6	6	6	6	6	6
	5. I in place–move marker to 10th bin	5	5	5	5	5	5	5	5
	4. I rotated–place I on top of A studs	4	4	4	4	4	4	4	4
	3. I in hand–rotate *Oregon* up and curved edge away	3	3	3	3	3	3	3	3
	2. Marker moved–reach for 9th bin and pull out I	2	2	2	2	2	2	2	2
	1. H in place–move marker to 9th bin	1	1	1	1	1	1	1	1
SEGMENT 2	16. H rotated–place H over 2nd C and 1st D stud	16	16	16	16	16	16	16	16
	15. H in hand–rotate #16 up	15	15	15	15	15	15	15	15
	14. Marker moved–reach for 8th bin and pull out H	14	14	14	14	14	14	14	14
	13. G in place–move marker to 8th bin	13	13	13	13	13	13	13	13
	12. G rotated–place G over 2nd B stud and 1st C stud	12	12	12	12	12	12	12	12
	11. G in hand–rotate; #16 up	11	11	11	11	11	11	11	11
	10. Marker moved–reach for 7th bin and pull out G	10	10	10	10	10	10	10	10
	9. F in place–move marker to 7th bin	9	9	9	9	9	9	9	9
	8. F rotated–place F over 2nd A stud and 1st B stud	8	8	8	8	8	8	8	8
	7. F in hand–rotate #16 up	7	7	7	7	7	7	7	7
	6. Marker moved–reach for 6th bin and pull out F	6	6	6	6	6	6	6	6
	5. E in place–move marker to 6th bin	5	5	5	5	5	5	5	5
	4. E rotated–place E over 1st stud	4	4	4	4	4	4	4	4
	3. E in hand; #16 up	3	3	3	3	3	3	3	3
	2. Marker moved–reach for 5th bin and pull out E	2	2	2	2	2	2	2	2
	1. D in guide–move marker to 5th bin	1	1	1	1	1	1	1	1
SEGMENT 1	17. D rotated–place in guide	17	17	17	17	17	17	17	17
	16. D in hand–rotate; studs up and curved edge away	16	16	16	16	16	16	16	16
	15. Marker moved–reach for 4th bin and pull out D	15	15	15	15	15	15	15	15
	14. C in guide–move marker to 4th bin	14	14	14	14	14	14	14	14
	13. C rotated–place in guide	13	13	13	13	13	13	13	13
	12. C in hand–rotate; studs up and curved edge away	12	12	12	12	12	12	12	12
	11. Marker moved–reach for 3rd bin and pull out C	11	11	11	11	11	11	11	11
	10. B in guide–move marker to 3rd bin	10	10	10	10	10	10	10	10
	9. B rotated–place in guide	9	9	9	9	9	9	9	9
	8. B in hand–rotate; studs up and curved edge away	8	8	8	8	8	8	8	8
	7. Marker moved–reach for bin and pull out B	7	7	7	7	7	7	7	7
	6. A in guide–move marker to 2nd bin	6	6	6	6	6	6	6	6
	5. A rotated–place in guide	5	5	5	5	5	5	5	5
	4. A in hand–rotate; studs up and curved edge away	4	4	4	4	4	4	4	4
	3. Marker moved–reach for bin and pull out A	3	3	3	3	3	3	3	3
	2. Attending to task–move marker to 1st bin	2	2	2	2	2	2	2	2
	1. Task set up–look at task	1	1	1	1	1	1	1	1

Date:

Time:

Comments:

FIGURE 2

Illustration of the task analysis data sheet.

tive stimulus without prompts or cues of any kind, performed the movement correctly, and made all necessary rotational discriminations. Any other response or failure to respond within 10 seconds was scored as incorrect. Observer agreement was checked during the first five probes and every eighth probe thereafter. During these 16 probes performance was scored simultaneously by the trainer and a second individual with vocational training experience.

Training Procedures

Training was conducted on one task segment at a time to allow measurement of progress within a multiple baseline design. Training continued on each segment until the trainee performed all steps in the segment correctly on three consecutive probes.

The trainee was seated in front of the task with the trainer either sitting beside or standing behind her. Early training sessions began when the trainee attended to the task for a few seconds. The trainer then modeled the first step, asked the trainee to perform the step, and provided differential consequences for correct and incorrect imitative responses. Correct responses were followed by compliments, physical contact, and small edibles. Incorrect responses were terminated by the trainer as soon as they occurred. The trainer returned the task to the last correctly completed step and, using more complete modeling or physical priming, assisted the trainee through a correct performance of the step. The trainer then returned the task once more to the last correctly completed step and repeated the procedure, providing much less physical or modeling assistance.

Each step was introduced in sequence via this modeling and priming procedure. After a step was performed correctly, the trainer no longer provided the modeling cue prior to the trainee's response. The trainee was expected to perform the step without prompts of any kind from the trainer, the relevant discriminative stimuli being provided by the task itself. Differential consequences for correct and incorrect responses were then provided as described above.

These procedures were modified during the training periods between probe trials 30 to 70 when the data indicated lack of progress. These modifiications were based on the trainer's hypothesis that correction procedures might be functioning as reinforcers for error responses. First, an attempt was made to maximize the difference between consequences for correct and incorrect responses. Incorrect responses were followed by a firm "No" before the correction procedure. When this had little effect, it was hypothesized that the physical contact involved in priming correct responses might be a strong reinforcer. These were deleted, but with little effect. Finally, an attempt was made to eliminate corrections altogether. This involved attempting to anticipate incorrect responses and provide necessary verbal or physical assistance before an error was made. When the trainee began to emit the correct response, the assistance was gradually removed by providing it earlier in the behavior chain (Bellamy, Inman, & Schwarz, in press) or making it less and less specific. This procedure continued throughout the remainder of training.

Results

Observer Agreement

Agreement between observers was computed by dividing the total number of agreements by the agreements plus disagreements on the 47 discriminated operants in the task. Agreement ranged from 98% to 100%. It is possible that this represents an overestimate, in that complete independence of observers was not achieved. Progression through the task during probes required the trainer (first observer) to complete a step performed incorrectly by the subject in order to assess responding to the subsequent step. Therefore, the second observer was aware when the trainer considered a step incorrect. After the initial probes, however, the second observer reported no instances when she felt the trainer had intervened inappropriately.

Task Acquisition

Acquisition data are presented in Figure 3. During the three probes before instruction, the subject made one correct response on Segment 1 (attending to the task) and no correct responses on either Segments 2 or 3.

Training on Segment I was conducted during 28 hours and 40 minutes over a two month period. A total of 82 probes were taken during this time, with performance on Segment 1 increasing from 4 correct responses on probe 4 to a criterion of 3 consecutive correct responses on probes 83 to 85. Correct responding on the remainder of the task ranged from 0 to 5 on Segment 2 and 0 to 6 on Segment 3. Inspection of Figure 3 reveals that little apparent progress was made during probes 30 through 70, the period in which several procedural modifications were made.

Training on Segment 2 required a total of 7 hours and 40 minutes during eight days of training. During the 23 probes taken during this time, the subject's correct responses to Segment 1 remained perfect; those to Segment 2 increased from 6 and 5 on probe trials 86 and 87 to a criterion of 3 consecutive correct trials on probes 10[illegible] through 109; correct responses on Segment 3 ranged from 0 to 9.

Training on Segment 3 was completed during 8 hours of instruction over nine days. During the 24 probes taken during this period, the subject maintained correct responding to all steps on Segment 1 and ranged from 14 to 16 correct on Segment 2. Correct responding on Segment 3 increased from 9 on probe 110 to the criterion level on probes 131 to 133.

Discussion

The subject learned to perform all three segments of the task independently after the training procedures were implemented. This result provides evidence for the existence of a functional relationship between the vocational training procedures and the trainee's skill acquisition. Because a multiple baseline design was used, attribution of skill acquisition to simple repeated exposure to a task or trainer, which has not been ruled out in most previous literature, could be seriously doubted in the present study. The trainee appears to have acquired each segment of the task as a function of beginning systematic instruction.

The results also provide a clear demonstration that a severely retarded person can learn the skills required to perform a complex vocational task. This is consistent with several other reports of the potential vocational competence of severely retarded persons (Bellamy, Peterson, & Close, 1975; Clarke & Hermelin, 1955; Crosson, 1967; Gold, 1976; Martin & Flexer, Note 1). Spanning two decades, these reports have illustrated that, with systematic training, severely handicapped adults could participate in remunerative work activity. However, their impact on vocational service programs seems to have been considerably less significant than the positive results might suggest. In spite of their apparent vocational potential, severely retarded adults frequently receive no work opportunities (Rowitz, O'Connor, & Boroskin, Note 2), or else

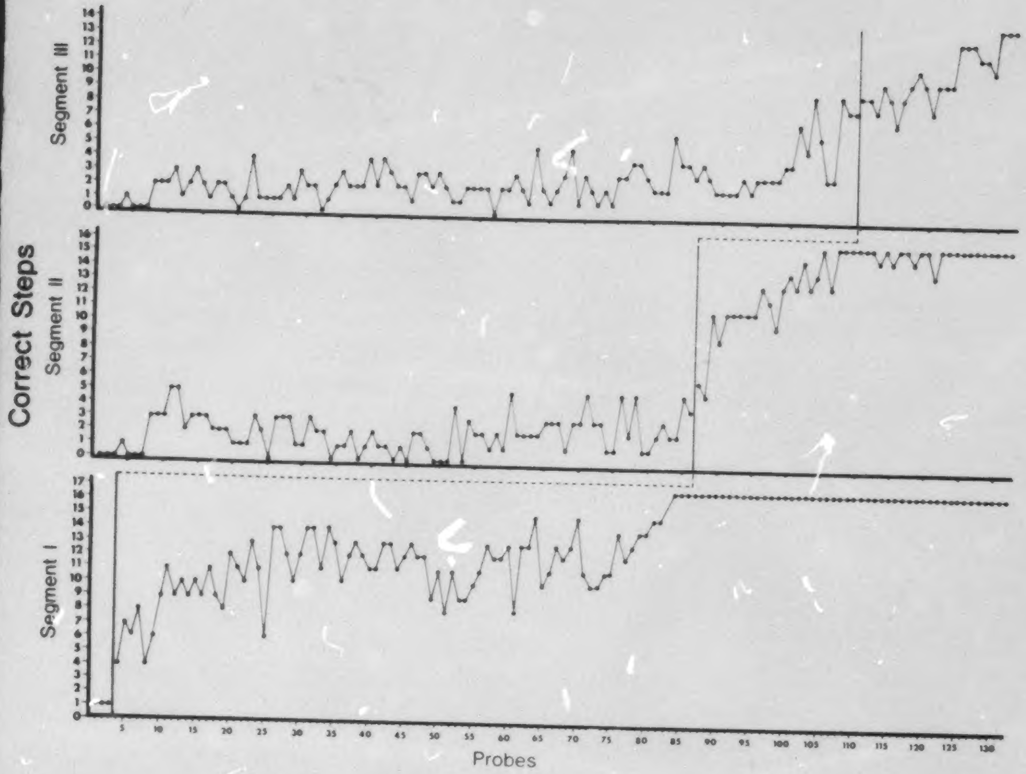

FIGURE 3

Number of steps completed correctly during unassisted probes conducted before and after training (vertical intervention line) on each task segment.

participate only in programs designed for adults whose "productive capacity is inconsequential" (Federal Register, 1974; Commission on Accreditation of Rehabilitation Facilities, Note 3).

Therefore, the question arises as to what researchers should now do to decrease this apparent gap between research and service programs. One approach is to continue reporting practical procedures for teaching vocational tasks which may be available to sheltered vocational programs. By illustrating the abilities of severely retarded adults to perform these tasks, an increased willingness to include these individuals in vocational programs may be fostered. A second possible role for applied research is in the development of more practical training and measurement procedures. The data sheet (Figure 2) used in this study appears to offer such a practical advance. Originally developed by Saunders and Koplik (1975) for use in classroom settings, the sheet provides a simple method of data collection which clearly delineates error patterns and allows for rapid graphing of individual progress.

A third task for applied researchers appears to be the development of training procedures which are increasingly efficient, thereby reducing the cost of including severely retarded persons in sheltered vocational programs. Related to this issue is the apparent increase in efficiency of training on successive task segments in the present study. Acquisition of Segment 1 required 28 hours, 40 minutes, while Segments 2 and 3 required only 7 hours, 40 minutes and 8 hours respectively. A possible explanation for this dramatic reduction in training time is that the subject acquired behaviors which facilitated performance in the training setting, including sustained attention to the task and consistent responding to verbal, physical, and gestural cues used by the trainer. Another potential explanation is the possibility of an increase in the trainer's skills in obtaining and reinforcing correct responses. A third possible explanation for the reduction in training time during Segments 2 and 3 seems particularly important. Training may have become more efficient because the trainee developed generalized skills or "operations" (Becker, Engelmann, & Thomas, 1975), which resulted in the correct performance of some untaught steps which were similar to those taught previously. For example, steps 7, 11, 15, 19, 23, 27, and 31 all involved obtaining one part from the bin behind the marker immediately after the marker had been moved. After training on a few of these steps in the first two segments, the trainee also began responding correctly to the steps which had not been taught. That is, the trainee had developed an operation of following a particular stimulus characteristic (the marker in front of a parts bin) with the response of reaching into that bin to obtain one part. This would suggest that generalization had occurred across the irrelevant dimensions of location of the bin and particular type of part.

This generalization poses a set of particularly interesting questions for future research on vocational training. For example, can a set of generalized skills, or operations, be identified which are applicable across several tasks typically found in sheltered workshops? Will pre-training on these skills increase a severely retarded individual's overall success in community vocational programs? And finally, can these operations be used as a basis for task selection and assignment decisions within workshops?

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Considerations in Dealing With Low Production Rates of Severely Retarded Workers

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Considerations in Dealing With Low Production Rates of Severely Retarded Workers

Increased attention is being paid to the possibility that severely and profoundly retarded adults may function as viable members of a community's work force (Bellamy, Inman, & Horner, in press; Martin & Pallotta, in press). Research assessing training (Bellamy, Peterson, & Close, 1975; Clarke & Hermelin, 1955; Crosson, 1967; Gold, 1974, 1976; Hunter & Bellamy, 1976; Irvin & Bellamy, 1977; Loos & Tizard, 1955; O'Neill & Bellamy, in press) and production (Bellamy, Note 1; Bellamy, Inman, & Horner, in press; Bellamy, Inman, & Schwarz, in press; Gold, 1973a, 1973b; Windle, 1962) techniques with the severely retarded clearly indicates that severely retarded individuals can learn complex vocational skills when appropriate training technologies are employed. This research also suggest that skills learned during training can be adequately maintained when proper maintenance procedures are used (Bellamy, Inman, & Yates, Note 2).

While research identifying effective training techniques is increasing, the majority of vocational research with the severely retarded has been focused on production management procedures (Bellamy, Note 1; Gold, 1973b). Specifically, researchers have been interested in the worker, task and setting characteristics that facilitate high rates of production. Recent reviews of this literature have even begun identifying guidelines for shop organization and supervisor behavior designed to optimize worker production rates (Bellamy, Inman, & Schwarz, in press; Martin & Pallotta, in press). The general focus of these guidelines, however, requires that they identify procedures *most* useful for *most* workers. Given that severely and profoundly retarded adults are a highly variable group (Grossman, 1973), production managers will need to supplement these general guidelines with additional options.

The present paper presents four studies from workshops affiliated with the Specialized Training Program, a contract workshop at the University of Oregon which employs severely and profoundly retarded workers. Each study describes a programmatic option taken with a worker who (a) had undergone intensive one-to-one training on a complex task prior to entering production, (b) had demonstrated the ability to perform at a reasonably high rate, yet (c) was maintaining a low work rate in a structured production setting. The production settings in the studies were all highly contingent environments, in which staff contact, tokens and/or edibles were delivered only when a worker performed appropriatey (cf. Bellamy, Inman, & Horner, in press; Bellamy, Inman, & Yeates, Note 2). The four studies describe effects of (a) differential reinforcement, (b) retraining, (c) self-delivery of reward, and (d) psychoactive drugs on the production rate of severely retarded workers.

Differential Reinforcement of High Production Rate

Most, if not all, workshops serving retarded adults provide workers with some type of reward during the work day. This reward may take many forms including social praise, money, edibles, tokens, or access to breaks. To the extent these potential reinforcers are available contingent on worker performance (e.g., completion of a unit of work) differential reinforcement is being used. It has generally been found that differential reinforcement is an effective method of improving production rate (Bellamy, Note 1; Bellamy, Inman, & Horner, in press; Bellamy, Inman, & Schwarz, in press; Gold, 1973b; Martin & Pallotta, in press).

Frequently, however, the improvement in a worker's rate will still leave him or her working below an economically significant level. For these workers additional intervention procedures are necesssary if the skills they acquire in training are to be vocationally viable. One option is to differentially reinforce high rates of performance such that a worker receives differentially more reward for work completed quickly. To ensure that all work completion behavior is rewarded, a modest reinforcer can be delivered for work that is done slowly, and a differentially greater reward can be made contingent upon a high performance rate. The present study examines the effects of adding differential reinforcement of high production rate (DRH) procedures to the reinforcement schedule of a worker already receiving reward for work completion.

Subject and Task

At the time of the study Eaon was 25 years old and employed in a community-based replication of the Specialized Training Program. Eaon's IQ was 25 as measured by the Stanford Binet experimental form for non-verbal and physically handicapped persons. Though he had demonstrated acceptable rates of production during training on a 520-step cable harness task, he was only performing at 13% of the industry norm following one week in the production setting.

Eaon's task involved assembly of a cable harness similar to that described by Hunter and Bellamy (1976). The cable was assembled by first sequencing 4 color-coded wires on a board. A continuous elastic cord was then used to lace the wires together with 30 self-tightening knots.

Procedure

An ABAB single subject design (Baer, Wolf, & Risley, 1968) was used to assess the effects of differential reward of high production rate. The phases of the study included (a) Baseline$_1$, (b) Differential reinforcement of high production rate$_1$ (DRH$_2$), (c) Baseline$_2$, and (d) Differential reinforcement of high production rate$_2$ (DRH$_2$).

During Baseline$_1$ Eaon received social praise for completing each cable, and five cents when he had correctly assembled three cables. Money earned during this phase was generally used to buy a cup of coffee at breaks. Following five days of Baseline$_1$, Eaon entered the DRH$_1$ phase. During this phase he continued to receive five cents for completing three cables, and continued to receive some social praise for being on task. Social praise following completion of a cable, however, became contingent on a fast rate of assembly. If Eaon completed a cable within a predetermined number of minutes he received vociferous social praise. If he took longer than this time criterion he received minimal attention. His favorable response to praise during training led supervisors to assume that social praise would function as a powerful reinforcer for Eaon. At no time was money made contingent on fast working.

This schedule ensured that completion of work was always rewarded, but that completion within the time limit was differentially rewarded at a higher level. The time criterion was computed daily by taking Eaon's average rate of production over the previous five days. This method of calculating the criterion both maximized the likelihood that Eaon would experience initial success, and provided an incentive for continual improvement as his production rate improved.

To provide Eaon with feedback on the amount of time he had to meet the criterion during DRH_1, supervisors would place a piece of masking tape over a part of the crystal of Eaon's wristwatch. If the cable was completed before the minute hand went under the tape he received the higher level of social reinforcement. The DRH_1 phase lasted 14 days.

Baseline_2 lasted eight days and exacly replicated the procedures of Baseline_1. The DRH_2 phase lasted 25 days and exactly replicated the procedures of DRH_1.

Results

During the five days of Baseline_1 Eaon averaged approximately 44 minutes for each cable assembly. As shown in Figure 1, this was only 13% of the standard rate of normal workers performing the same task.

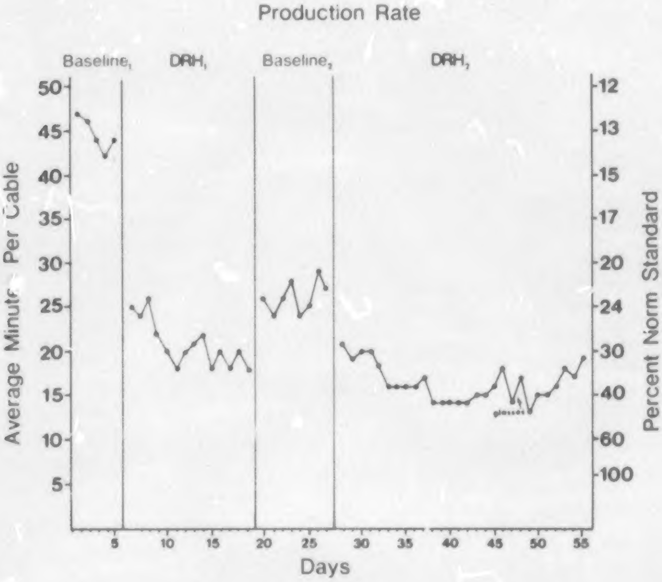

FIGURE 1

The average number of minutes per cable assembly, and the percent of norm standard per day across all phases for Eaon.

When Eaon began receiving additional reward for high rates of performances in the DRH_1 phase, a dramatic reduction in the minutes required per cable was observed. During the last five days of this phase he averaged 19 minutes per cable. This is clearly a significant improvement over the Baseline$_1$ phase.

When differential reward of high production rate was terminated, and the Baseline$_2$ phase begun, there was an immediate increase in the number of minutes Eaon took to complete a cable. As shown in Figure 1, both the level and slope of Baseline$_2$ data indicate a deterioration of production performance in this phase.

A return to differential reward procedures in the DRH$_2$ phase produced a shift in both the level and slope of the production rate data. During DRH$_2$ Eaon gradually decreased the number of minutes required for each cable until he was working at almost 50% of the standard for normal workers performing the cable task.

Forty-seven days into the study Eaon received glasses. As shown in the DRH$_2$ phase, there was a gradual increase in the number of minutes taken per cable after he received his glasses. While lack of experimental control precludes discussion of any functional relationships, close observation of Eaon's behavior suggested this gradual increase may have been related to the excessive amount of time Eaon spent manipulating his new glasses. After each step in the task he would adjust his glasses. Further observation revealed that Eaon performed a variety of similar behaviors that were also irrelevant for completion of the task. It was felt that without these irrelevant behaviors Eaon's rate of performance would have been significantly closer to that of normal workers.

Discussion

Across the [illegible] days of the study Eaon's rate of performance improved from 13% to almost 50% of norm standard. The fact that the data follow an ABAB reversal pattern is strong evidence for a functional relationship between DRH procedures and improved production performance. These data replicate findings reported by Bellamy, Inman, and Yeates (Note 2). The present data, however, were collected in a community-based, rather than a university-based workshop. Clearly the staff demands required to run such an idividualized supervision program are not beyond the resources of a community facility.

In addition to demonstrating the effectiveness of the DRH procedure, data from the present study raise two concerns. The first comes from asking if a production rate of 40 to 50% norm standard should be considered a success. Given that Eaon had demonstrated near normal performance rates during training, staff were hesitant to proclaim the study a success and terminate their intervention.

It would appear more realistic to view production rate as a complex behavior affected by many different variables. Manipulation of reinforcement schedules was clearly one of these variables for Eaon. Receiving glasses may have been another. The fact that rate stabilized and began to deteriorate during the last half of DRH$_2$ suggests that the effects of the DRH procedure may have been maximized, and further increases in performance rate would require manipulation of other variables. Unfortunately, the workshop in which data were collected is designed to run as a small business, not a research site. As such, both staff and employees must be responsive to the unpredictable demands of industry. Towards the end of the DRH$_2$ phase it became clear that Eaon would be needed for work on a different contract if production deadlines were to be met. This shift in work assignment forced termination of the study and precluded assessment of further manipulations.

A second concern raised by the data relates to the upward trend in minutes per unit over the last seven days of DRH$_2$. While a lack of experimental control prevents analysis of events functionally related to this trend, it is clear that Eaon's work rate was deteriorating. Staff observations indicating a high frequency of irrelevant behaviors suggest some loss of stimulus control. The extent to which a worker can perform at a high production rate will be dramatically affected by the degree to which work behaviors are under stimmulus control. If this control breaks down or is suspended, work rate will suffer. The possible role stimulus control may play in a worker's rate of production is hinted at by the present data, and dealt with more directly in the following retraining study.

Retraining

When a worker completes training and enters production, s/he should be correctly performing each response required by a task, and each of the responses should be under control of task-relevant stimuli. Once in production some workers may increase their rate of performance without any further intervention (Bellamy, Inman, & Yeates, Note 2; Gold, 1973b). Unfortunately this pattern is not completely representative of severely and profoundly retarded workers as a population. Frequently a worker's production rate either markedly decreases during his or her time in production, or if some improvement does occur it still leaves the worker performing at a less than economically significant level. Observation of workers at Specialized Training Program sites suggests that one possible factor contributing to limited rates of performance is the addition of irrelevant behaviors to the operant chain of reponses defining a task.

The addition of irrelevant behaviors (i.e., pauses, self-stimulation, realigning of the task, etc.) suggests that the stimulus control of task-relevant responses developed during training has broken down. Two likely possibilities are (a) that stimuli which had previously controlled task-relevant behavior have lost that control and now either serve as neutral stimuli or set the occasion for irrelevant responding, and/or (b) that non-task related stimuli in the production setting have greater control over irrelevant responses than task-related stimuli have over the task-appropriate responses.

Retraining is one programming strategy which may be useful for workers whose production rate is inadequate due to poor stimulus control. Retraining refers here to termination of production management contingencies and reintroduction of one-to-one training contingencies (e.g., Bellamy, Inman, & Schwarz, in press). The objective of retraining is two-fold: (a) to regain stimulus control of task-appropriate responses with a trainer present, and (b) to transfer this control to task-relevant stimuli. This study evaluated the effects of retraining with one severely retarded worker.

Subject and Task

At the time of the study the subject, Judy, was 28-years old. She had been diagnosed as Downs Syndrome at birth and placed in a group home. At age four she was institutionalized. Institutional records label Judy as severely mentally retarded, at AAMD Adaptive Behavior Level IV. Approximately one year prior to the study Judy was removed from her institutional residence, and placed in a community group home facility. Simultaneously, she began employment in the Specialized Training Program.

Training procedures described by Bellamy, Inman, and Schwarz (in press) were used to train Judy on a vocational task which involved pasting cushioning tape in the four inside corners of an 18 cm tall funnel-like apparatus used by Tektronics, Inc., to shield electronics elements from heat. Specifications for correct tape placement were: (a) the tape itself had to measure no more than 4.4 cm and no less than 3.2 cm in length; (b) tapes needed to be positioned directly in the converging angles of the corner; and (c) tapes had to be no more than 2.46 cm and no less than .3 cm below the outer lip of the heat shield. Deviation on any of the above dimensions constituted an error.

During the first several weeks in production Judy performed the task at acceptable levels of efficiency and accuracy. It was not long, however, before she was observed to be adding pauses and extraneous movements to the task. Concomitantly her task efficiency and accuracy decreased.

Procedure

The study consisted of the following four phases: (a) Baseline; (b) Retraining; (c) Fading; and (d) Maintenance. Baseline data were collected on rate of production and frequency of errors during the four and one-half hours Judy was in production each day. During Baseline she received differential social praise for performing appropriate task-related behaviors and a token each time she completed three shields. Tokens were used to buy edibles at the end of work periods.

During the Retraining phase of the study one-to-one training was provided throughout the entire work day. One of three trainers would stand behind Judy while she performed the task in the production setting. The retraining intervention was intended to increase production rate, alleviate incorrect placement of tapes, bring appropriate responding under stimulus control, and eliminate the extraneous behaviors (pausing, excessive manipulation of parts, etc.) developed in the production environment. To this end, if Judy looked away from the task for more than two seconds a trainer would physically reorient her to the task. If she paused for more than three seconds a trainer would physically prime her on her right tricep. If Judy placed a tape incorrectly an immediate correction procedure was implemented in which she was prompted through a correct placement and then asked to perform the step again independently (cf. O'Neill & Bellamy, in press). Correct tape placement was verbally praised and task completion was rewarded with tokens. In addition, supervisors continued to deliver verbal praise for on-task behavior.

Fading began only after Judy was consistently performing her task at an average rate of 10 minutes or less in Retraining. The Fading phase was designed to gradually transfer control of on-task behavior from trainer-provided stimuli to task and production setting stimuli. During Fading both proximity of the trainer and density of reinforcement were gradually changed to approximate the proximity of production supervisors and density of reinforcement normally occurring in the production setting.

During Retraining trainers stood next to Judy and delivered praise for correct placement of two consecutive tapes. In the Fading phase, this schedule was gradually leaned out to every third tape, then every fourth tape and so on until only after correctly completing three shields was praise delivered. In addition, trainer proximity and level of attention were faded. Trainers began by simply standing further away from Judy as she worked, and then gradually increased the physical distance between themselves and Judy, while gradually decreasing the overall amount of individual attention she received.

The final phase of the study was designed to be a long-term assessment of how well gains developed in Retraining were maintained. A vacation and contract completion interrupted data collection five days into the phase. After a several week pause Judy returned to the shield contract. The last two data points in the maintenance phase were collected four months after she had returned to shield production. During the maintenance phase procedures replicated those of the initial baseline phase except error data were not collected.

Results

The rate and error data across all phases of the study are provided in Figures 2 and 3. Baseline data indicate that Judy was assembling shields at an average of between 22 and 88 minutes per shield. Her minute/unit rate was extremely variable during the seven days of Baseline, and considerably higher than the 1.2 minutes required by normal workers. Her error data during Baseline indicated a similar trend towards high variablity and poor performance.

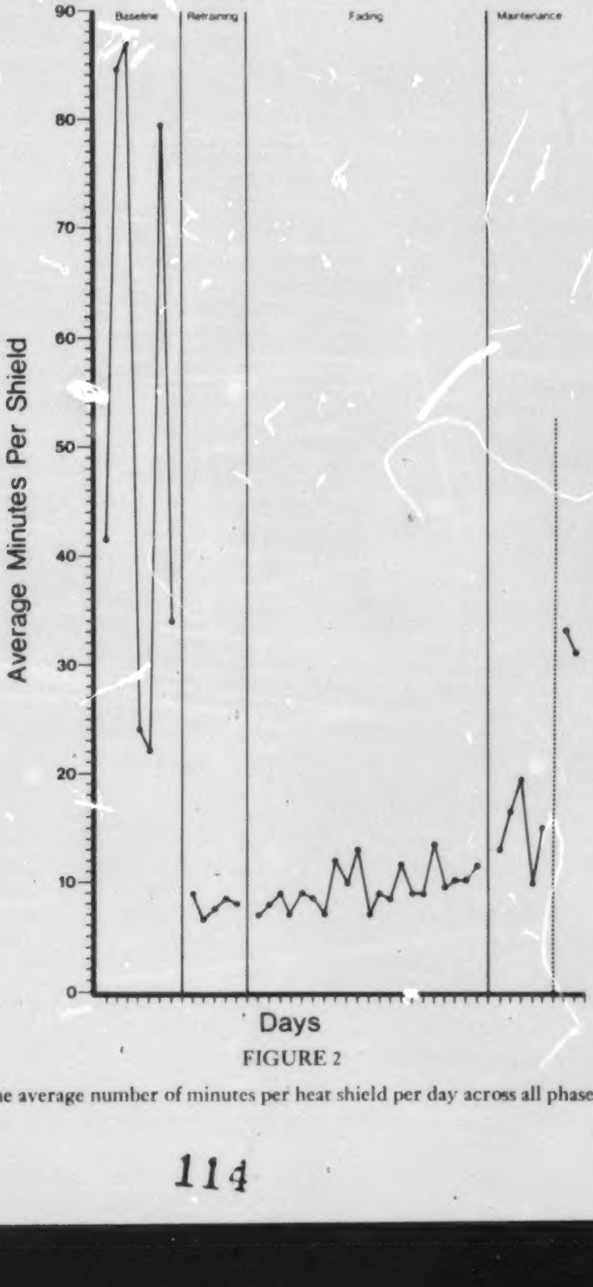

FIGURE 2

The average number of minutes per heat shield per day across all phases.

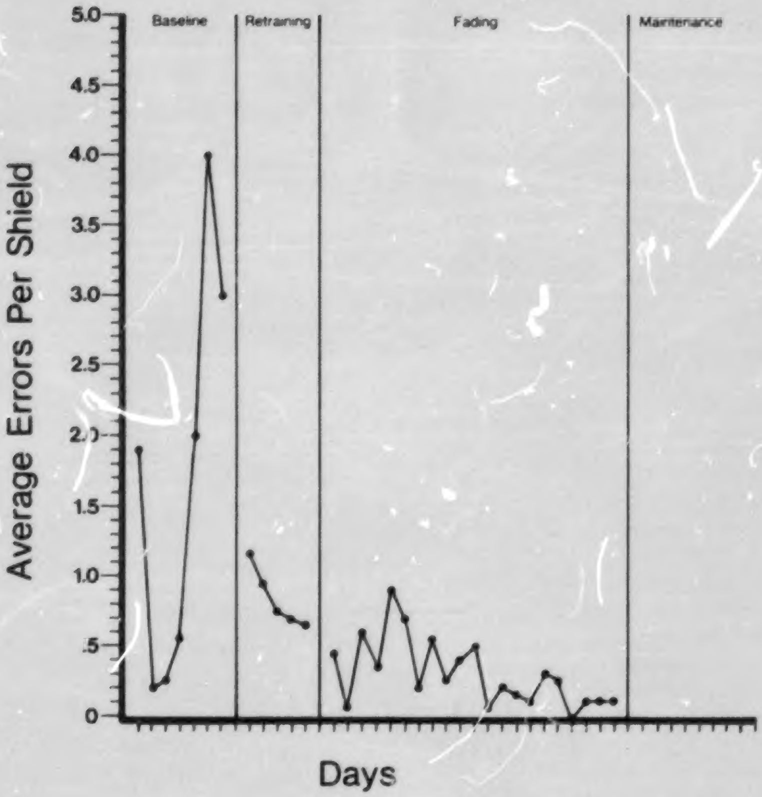

FIGURE 3

The average number of errors per heat shield per day across all phases.

Retraining produced a marked reduction in both level and stability of Judy's production rate. During the five days of Retraining she required an average of only 7.8 minutes to complete a shield. This is a substantial improvement over her baseline performance. In addition, her error rate stabilized and began steadily dropping.

Data from the Fading phase indicate a slight upward trend in the number of minutes Judy required to assemble a shield. Conversely, the number of errors gradually reduced to a negligible rate.

The initial five days of maintenance indicate that Judy's production rate was not maintaining. The trend established during Fading continued, and a slight increase in variability was observed. The final two points taken four months after she returned to production indicate a substantial loss of the gains developed during Retraining. Judy's rate had returned to a level near that observed during Baseline.

Discussion

The marked improvement in both rate and error performance when Retraining was first implemented suggests that antecedent and/or consequent events associated with trainer-provided stimuli may have affected Judy's behavior. This would be expected given the high density of reinforcement used during Retraining. It was anticipated that over time stimuli associated with Retraining (i.e., task, setting and trainer stimuli) would come to act as discriminative stimuli (S^D's) for working at a fast, accurate pace. Once these stimuli had come to control fast, accurate work the intervention procedure was designed to fade out trainer stimuli. The Fading process would theoretically facilitate transfer of any control maintained by trainer stimuli to stimuli provided by the task or setting. In either case the worker would be expected to maintain high rates of performance without continuous one-to-one contact.

Judy's data indicate that the desired improvement occurred during Retraining, but that as soon as Fading procedures began her rate gains started deteriorating. It is possible this was a function of the short duration of the Retraining phase. Stimulus control may not have been firmly established before Fading began. Another possibility, however, is that Judy's improved behavior during Retraining was not related to the positive contingencies associated with Retraining but to avoidance of negative contingencies. The effect of Retraining may have been to teach Judy that if she wanted to avoid being prompted or corrected she needed to work quickly and accurately. If this were the case, trainer-related stimuli would still be expected to produce improved production behavior. However, it would be unlikely that the Fading procedure would effect transfer of stimulus control from trainer-related to task-related stimuli. As such, a loss of control similar to that observed over the Fading and Maintenance phases would be expected when trainer cues were removed. This analysis would mesh with the fact that error performance did not deteriorate during Fading. Errors during Fading continued to be corrected even though they occurred at a low rate.

The above analyses are but two of many that would fit the data. Unfortunately, the present design is open to analysis from a wide variety of perspectives due to its lack of experimental control. Judy's data do, however, raise several issues pertinent to production rate programming with the severely retarded. The first is the importance of evaluating any intervention strategy based not only on its immediate effect, but on maintenance of that effect. Regardless of the type of manipulation or intervention used, long-term maintenance is an absolutely pivotal dimension against which the success of an intervention should be measured. The present intervention did not meet this criterion of success.

The second issue relates to the fact that Retraining was implemented only after Judy had spent several weeks performing the task with numerous sets of extraneous behaviors. Over time a number of stimuli in the production environment may have come to control inadequate performance. It would not be surprising then that elimination of such behavior did not occur after only five days of Retraining. This suggests that managers in production settings should intervene at the earliest possible moment once consistent patterns of inappropriate behavior are identified. Early intervention would both prevent the worker from repeatedly practicing the inappropriate behavior, and minimize the extent to which work-setting stimuli come to control the inappropriate responses. Clearly the most effective way to recognize consistent inappropriate behavior patterns will be through maintenance of a well-organized system of data collection (e.g., Bellamy, Inman, & Horner, in press).

A final issue raised by the present study revolves around the cost in staff time required to retrain. The Retraining intervention utilized 90 minutes per day from three staff members over a period of 26 days in an attempt to rectify production inadequacies. Even if the program had been completely successful the expense in staff time would have been substantial. This suggests that careful consideration should be given to original training and production variables that may preclude the need for retraining. These considerations suggest that a stiff training criterion, and immediate production manipulations when rate first begins to decline, may minimize retraining needs.

Self-Delivery of Reward

Acquisition of vocational skills by severely retarded individuals will be economically practical only if those skills can be performed at a competitive rate, with a minimum degree of supervision. A number of researchers addressing this issue have found that contingent delivery of reinforcement is one effective method of improving production rate (Bellamy, Inman, & Yeates, Note 2; Crosson, 1967; Martin & Pallotta, in press; Zimmerman, Stuckey, Garlick, & Miller, 1969). As yet, however, it is unclear how this reinforcement can be delivered without a substantial time commitment from supervisory staff. One possible method of providing a high density of reinforcement with a minimum cost in staff time can be found in literature on self-management.

Self-management techniques with normal populations have proven effective methods of controlling behavior (Mahoney & Thoreson, 1974; McLaughlin, in press; Miller, 1975). Recently, techniques such as self-delivery of reward, and self-monitoring have been used successfully with exceptional populations (Helland, Patuck, & Klein, 1976; Horner & Brigham, Note 3). Data from these studies suggest: (a) that individuals with low IQs can learn to reliably self-deliver consequences for their own behavior, and (b) that self-delivered rewards are as effective as staff delivered rewards. One study conducted in the Specialized Training Program has examined the effects of self-delivered rewards on the production rate of a severely retarded worker.

Subject and Task

The subject participating in the study, Phil, was 32 years old at the time the study was conducted. Phil had been institutionalized 11 years of his life and his files indicated severe mental retardation. Phil entered the production setting following intensive one-to-one training at the Specialized Training Program (Bellamy, Inman, & Schwarz, in press). When training was complete he could perform each of the 34 steps required to assemble a 10 part test adapter used by Tektronics, Inc. The standard time required by a normal worker to perform the assembly was 10 minutes. After several months in production, however, Phil was averaging almost twice this time for task asembly.

Setting

Phil assembled adapters in an 802 square foot room with thirteen other workers employed on other contracts. Two supervisors circulated throughout the room delivering social praise for on-task behavior, and ensuring that all workers had sufficient parts and equipment. When Phil completed an adapter he would raise his hand, and a supervisor would inspect the quality of his work. If the adapter did not meet industrial quality standards, Phil was shown his error and asked to redo the unit. If the adapter met industry standards he was praised, given a token, and the number of minutes required to complete the adapter was recorded. Tokens were exchanged later in the work day for edibles.

Procedure

The four phases of the study included Baseline$_1$, Self-Delivery$_1$, Baseline$_2$ and Self-Delivery$_2$. During both Baseline phases, supervisors delivered tokens and praise for work completion. During the Self-Delivery phases the subject delivered his own tokens. The frequency of supervisor praise for on-task behavior was held constant across all phases of the study. Supervisor praise for work completion, however, was not delivered during the self-delivery phases.

The first Baseline phase began after Phil had been in the production setting for several months. This phase lasted 34 days, and followed the production setting procedures described above. Following the Baseline$_1$ phase, a 2-day training period was conducted in which Phil was taught to do his own quality control checks. Given that the only errors Phil ever made involved insufficient tightening of screws, the quality control procedures required him to shake the adapter after he had completed assembly. Quality control standards were met if the adapter did not rattle. If the adapter rattled when shaken it did not pass the quality inspection. Upon hearing the rattle, Phil would raise his hand, and receive specific directions from a supervisor on what to correct. If the adapter did pass the quality control inspection he would place it in a box, and activate a small wooden lever which pushed one token onto his work bench. The tokens were accumulated during 90 minte work periods, and exchanged for edibles at the end of each work period.

When Phil self-delivered the token a bell automatically sounded. The bell was a signal to supervisors to record the number of minutes required to complete an adapter. This ensured that data recording procedures were constant across all phases. All adapters Phil identified as meeting quality standards were later inspected by supervisors at the end of the work period.

Self-Delivery$_1$ procedures were in effect for 31 work days. At this point Baseline$_2$ conditions were introduced. Inspection and delivery of reinforcement were again done by supervisors. The second Baseline phase lasted 24 days before self-delivery procedures were reinstituted. The Self-Delivery$_2$ phase lasted 26 days and replicated Self-Delivery$_1$ exactly.

Results

Data across the four phases of the study are provided in Figure 4. During the 34 days of the first Baseline phase, Phil worked an average of 19 minutes to complete an adapter. In the first self-delivery phase, however, he improved this rate of productivity, requiring an average of only 12 minutes to complete an adapter. Across the last 10 days of Self-Delivery$_1$ a mean of only 10 minutes per adapter was required.

When Baseline$_2$ procedures were introduced, Phil's rate of productivity returned to a level near that observed in the original baseline phase. During the last 12 days of Baseline$_2$ an average of 21 minutes was taken to complete each adapter.

A dramatic reversal in the number of minutes taken per unit was noted when Phil again started self-delivering reward. During the Self-Delivery$_2$ phase just under 12 minutes were taken to complete each adapter. The temporal link beween change in method of reinforcement across phases, and change in production rate argues strongly that self-delivery of reward was functionally related to improved performance.

Throughout the study Phil self-delivered incorrectly only twice. On both occasions he gave himself two tokens instead of one. One of these instances

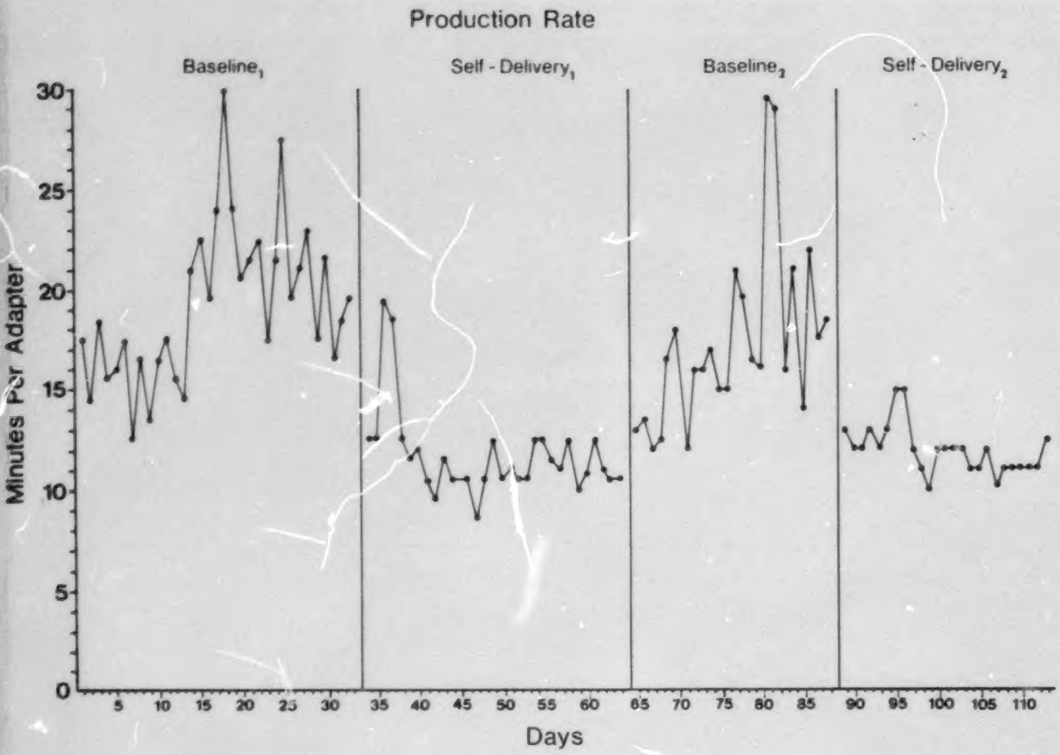

FIGURE 4

The average number of minutes required to assemble an adapter per day over all phases.

was due to a clogging of the token-delivering apparatus. Phil never self-delivered a token for unacceptable work. This may be due in part to the easily discriminable quality control standards required by the task.

Discussion

This study replicates data reported by Helland, Patuck and Klein (1976) indicating that severely retarded individuals can be trained to accurately self-deliver reward. However, Helland, et al., found that self-delivery and external delivery of rewards were equally effective in controlling behavior. The present data indicate that self-delivered rewards were not only as effective, but more effective than supervisor delivered rewards. This is a curious finding given that the same tokens were delivered on the same schedule across all phases of the study. It is possible that access to the token-delivery apparatus, was, in itself, reinforcing. If this were the case, however, it might be expected that the effect would attenuate over the several weeks of each self-delivery phase. This did not occur. In addition it is possible that self-delivery of tokens increased the reinforcing value of the token. Further study of this possible effect is clearly needed.

In interpreting the discrepancy between performance rates during Self-Delivery and Baseline phases, it must also be noted that the latency between unit completion and reinforcement was shorter during the self-delivery phases. During baseline phases Phil would have to wait for a supervisor to come to his work station, inspect his adapter and deliver a token. This process generally consumed between 30 and 60 seconds. During the Self-Delivery phases this latency was negligible. Two effects are possible given this difference between phases. First, the Baseline procedures artificially added up to 60 seconds on a work unit. It should be noted that eliminating this extra time would not in and of itself account for the magnitude of rate improvement, reduction in variability or changes in trend that were observed when Phil was self-delivering rewards. Second, the immediate delivery of a reward has long been known to increase its functional effect as a reinforcer. It is likely therefore that the reduced latency between performance and token delivery in the self-delivery phases increased the degree to which the token functioned to reinforce work behavior.

The present results strongly suggest that self-management techniques should be further explored in workshop settings. These techniques may be valuable methods of improving and maintaining high levels of performance. Future research should assess not only the effects self-delivery has on production rate, but its effect on supervisor time and overall shop efficiency.

Drugs and Production Rate: An Unplanned Study

Severely and profoundly retarded adults often behave strangely by normal social standards. Nevertheless, it is increasingly apparent to those who work with these individuals that their strange behaviors "make sense" as a means of adapting to the demands of their environments. In the workshop situations described in this paper, a pervading assumption is that behavior is usually some sort of adaptation to an environment. Thus, behavioral change procedures are developed by focusing one's attention upon the identification of both the stimuli and the consequences functionally related to performance of a given kind of deviant behavior. Attempts to change behavior then involve the systematic manipulation of the environmental antecedents and/or consequences of that behavior.

Many clinical environments, however, practice a form of behavior management based upon a "medical or pathological model" of psycho-pathology (Goldiamond, 1974). As a result, unusual behavior patterns, which often contribute to an individual being labeled severely or profoundly retarded, are seen as an overt representation of an underlying pathological condition implying organic or biological defects. From the point of view of the medical model, the logical treatment of choice is frequently one, or commonly a combination, of the wide variety of biologically mediated psychoactive drugs now universally available. Unfortunately, the effect of some psychoactive drugs extends beyond the environment in which the medical model is prevalent and into environments where the behavioral model is functioning effectively.

The present study is an example of the effect one particular drug had on one worker in a workshop setting. The data are drawn from an unplanned study and are available only because it is normal procedure to carefully monitor, by means of daily up-dated graphs, the production rates of each severely or profoundly retarded worker.

Subject and Task

Lani was one of the first severely retarded entrants into Alpha Production Technologies, Inc., a community-based replication of the Specialized Training Program. In the course of her first six months in the program Lani was systematically trained on increasingly complex assembly tasks. Each of Lani's assembly tasks was organized by means of chaining individually easy steps into more complex organizations of productive behavior (Bellamy, Inman, & Schwarz, in press). At the time of the unplanned study, she was fully independent in her assembly of an eleven-piece grounded extension cord plug which required approximately fifty individual assembly steps. Lani's average time-to-completion for one plug was five and one-half minutes. Normally she would work steadily in each of her four, one and one-half hour work periods. She was cheerful, relatively industrious, and socialized well with her co-workers and staff. Lani's only bizarre behaviors were the biting of a large oval callous on her right forearm and a rocking motion which she would occasionally intensify to the point of bringing her head into damaging contact with whatever was behind her. These behaviors had dropped to a low rate following implementation of contingent staff praise for appropriate behavior, and ignoring of biting and rocking behavior. This drop demonstrated Lani's responsiveness to basic behavioral manipulations.

Procedure

The three phases of the present study assess the effects of a commonly used psychoactive drug (Haldol), on Lani's production rate. The phases of the study were Baseline$_1$, Haldol, and Baseline$_2$. The dependent measure across all phases was production rate measured by the average number of minutes required for assembly of extension plugs. The independent variable was the administration of Haldol in Lani's home environment.

Baseline$_1$ involved normal production procedures similar to those described earlier. At home, however, Lani was receiving 5.4 mg/kg (300 mg) of Mellaril per day. This medication was one she had been taking for a substantial time period.

The Haldol phase began when managers in Lani's home environment arranged to have her medication shifted from 5.4 mg/kg of Mellaril to .09 mg/kg (5 mg) of the more potent drug, Haldol. The administration of Haldol was precipitated by Lani's excessive negativeness and tantruming in the home setting. The change was made without the knowledge of the workshop staff. Haldol was administered for four days.

The Baseline$_2$ phase replicated procedures in Baseline$_1$. Lani was shifted back to her original 5.4 mg/kg of Mellaril.

Results

Lani's average rate of production across all phases of the study is provided in Figure 4. During the 15 days of Baseline$_1$, she averaged 5.5 minutes per plug assembly. This is approximately 50% of the standard industrial rate for this task.

In the medication condition there was a dramatic increase in the average number of minutes taken per plug. The slope of the production rate data during this phase clearly indicates a substantial deterioration in Lani's performance.

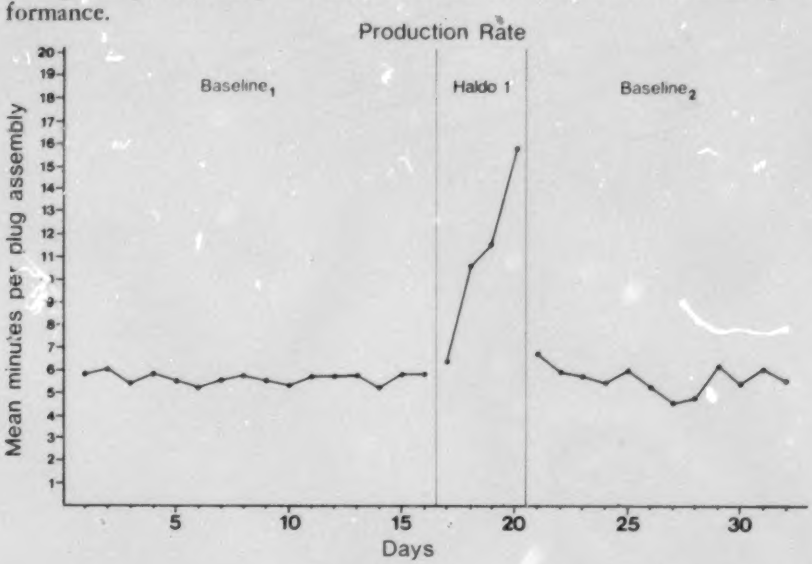

FIGURE 5

The average number of minutes required per plug assembly per day over all phases.

Accompanying Lani's change in production rate were equally noticeable changes in her overall behavior. She fell asleep during lunch, drowsed during work and became self-abusive when attempts were made to prompt her to work. A consultation with her home staff was held at which time workshop staff were informed of the medication change. Following analysis of Lani's production rate graph, staff from both workshop and home environments agreed to reimplement her original medication schedule. Following return to Mellaril, Lani's production rate immediately returned to Baseline$_1$ levels.

Discussion

The above data clearly indicate that Lani's production rate was functionally related to the change from Mellaril to Haldol. The generalizability of these results is somewhat limited, however, given that (a) there is no data to suggest what effects Mellaril had on Lani's behavior; and (b) no placebo controls were used.

The dramatic effect the medication change appeared to have on Lani's behavior does, however, require consideration by individuals responsible for managing the environments of severely and profoundly retarded adults. If our goal is to help a population of disadvantaged individuals by enabling them to be involved in the productive activities of our society, then they should be given an opportunity which is as favorable to their success as possible. Where being involved in society's productive activities translates into an interest in high rates of behavior, certain kinds of commonly prescribed drugs may be inimical to successful socio-economic integration.

If a drug (stimulant or suppressant) is used to control the behavior of a retarded individual, careful consideration should be paid to the effects the drug will have on all aspects of the individual's behavior, not just its effects on a specific targeted behavior. Subjective reports from staff in Lani's home environment indicated that Haldol was effective in reducing her frequency of negative and abusive behaviors. Yet, the drug was also effective in reducing a large percent of all of Lani's behavior (acceptable and unacceptable). The decision to drop adminstration of Haldol with Lani was made partly because the effects of the drug were seriously impeding her ability to behave adaptively in the workshop, and partly because she had demonstrated a marked responsiveness to behavioral intervention in the workshop setting. It was felt that a more accountable method of dealing with Lani's negative behavior woud be to manage antecedents and consequences specifically related to that negative behavior. Such a program is currently being implemented.

If normalization, deinstitutionalization, and increased independence are to become terms that have a positive functional meaning for severely and profoundly retarded adults, emphasis must be placed not simply on reducing negative behaviors, but on training positive (adaptive) behavior. If a treatment designed to alter a negative behavior seriously impedes an individual's ability to perform appropriately, that treatment should be carefully reviewed prior to implementation. One aspect of this review process should include demonstration that less intrusive treatment strategies, such as those of applied behavior analysis, are impractical.

Conclusions

The four studies discussed above provide a variety of perspectives from which the low production rates of some severely and profoundly retarded workers can be assessed. Each of the studies discusses variables which may affect individual productivity. Given that the significance of vocational training with the severely retarded will largely rest on the rate at which workers perform, it is imperative that researchers and production managers begin clearly identifying those variables which affect rate.

The above studies indicate that the speed at which a worker performs is a complex behavior. It may be affected by a variety of stimulus situations or schedules of consequation. As yet, we have only a very global understanding of production rate issues. One important area of research need with the severely handicapped continues to be a fine-grained analysis of variables affecting production rate.

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Effectiveness and Generalization of Overcorrection Procedures with Stereotyped Behavior of a Severely Retarded Adult

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Abstract

A 38-year-old severely retarded woman who exhibited high rates of self-stimulation behaviors was exposed to an overcorrection procedure during the morning break in a sheltered workshop. Rates of self-stimulation behaviors were monitored during these breaks and in three other settings. The treatment, implemented in an ABAB design, appeared functionally related to significant reduction in the behavior in the treatment setting. The results are of particular relevance to programs in which limited staff resources effectively prevent intervention in all situations. The data also emphasize the need for evaluation of program effectiveness on the basis of behavior change in non-treatment settings.

Effectiveness and Generalization of Overcorrection Procedures with Stereotyped Behavior of a Severely Retarded Adult

Structured behavior change programs can seldom be implemented in all situations in which behavioral change is desired. Strategies for achieving cross-setting generalization of treatment effects thus attain considerable importance. Several suggested procedures are now available, including, for example, training across a number of examples (Stokes, Baer, & Jackson, 1974), overlearning (Gold, 1972), manipulating the treatment environment to increase similarity to natural settings (Baer, 1973), and developing generalized skills in initial instruction (Becker, Engelmann, & Thomas, 1975).

Although such a list of recommended procedures may assist in the development of practical treatment programs, it is clearly not sufficient. A cornerstone of applied behavior analysis has been that all treatment procedures, regardless of their utility with other individuals, be evaluated empirically in each new application (Biglan & Kass, 1977). In designing treatment programs to facilitate generalization, therefore, the issue is not whether the program incorporates any specific procedural recommendation. The focus should rather be on the empirical question of whether implementing the treatment in one setting is functionally related to behavior change in other settings of interest. The purpose of this paper is to emphasize the empirical aspect of treatment selection by describing and evaluating a procedure for reducing an individual's stereotyped behavior in both treatment and non-treatment settings.

Method

Subject

The subject was a 38-year-old woman, labeled severely retarded, employed at the Specialized Training Program, which is a sheltered workshop for severely handicapped adults at the University of Oregon. At the time of the study, she had lived in a group home for retarded adults for approximately 14 months after having been institutionalized for over 20 years. The topopgraphy of her stereotyped behavior involved pinching and touching her face and neck which caused a reddening of the skin and concern that an infection would ensue because of unhygienic toiletting and eating habits. The behavior also interfered with several behaviors considered adaptive by program staff and other interested persons, e.g., acquisition of vocational skills, social interaction, etc.

Materials and Setting

The subject's behavior was observed in four settings: the workshop setting during production, during work breaks, during lunch, and in the group home during free time before dinner. In the *production setting*, the subject was one of 14 other workers who performed contracted assembly tasks at individual work benches. Two production supervisors provided social contact contingent upon on-task behaviors, performed quality checks of completed products, and managed a token economy system designed to maintain and increase individual production rates. *Work breaks* took place at mid-morning, after one and three-quarter hours of work, in a lunchroom adjacent to the production setting. Workers exchanged tokens for snacks, ate these, and relaxed for 10-15 minutes. The *lunch period* occurred two hours later in the same lunchroom. Time during lunch was occupied by obtaining food, eating, cleaning up, and some free time. The *group home* was a residence for the subject and nine other shop employees. During the hour before dinner each (weekday) evening, the subject typically had free time which was usually spent sitting in a rocking chair or on a couch. Materials used during the study included a data sheet and clipboard to which a timing device was attached that produced an audible signal every five seconds.

Measurement

The targeted stereotyped behavior was defined as touching or pinching either the face or neck with one or both hands. Each day the subject was observed for approximately 20 minutes in each of the four settings. In all but the production room, this included the first 20 minutes in that setting each day. Because of the large amount of time spent in production, different 20 minute time blocks were selected each day with no known selection bias. The observer watched the subject from behind a one-way mirror, except in the group home, where the observer was in the same room but did not interact with the subject. At the sound of each 5-second signal, the observer recorded the occurrence or non-occurrence of the targeted behavior. Observer reliability was established by a percent agreement method, dividing the number of agreements within each observation interval by the number of total observation intervals. A total of 15 reliability checks were made across all conditions. Each resulted in agreement of 95 percent or greater.

Procedure

An ABAB design was used to evaluate the relationship between treatment procedures and behavior change in the treatment setting and three non-treatment settings. Baseline conditions remained in effect throughout the study in all non-treatment settings. During baseline conditions no special contingencies were added to the naturally occurring events in the four settings.

Intervention occurred only during 20 minute work breaks and involved consequating each instance of the stereotyped behavior with an overcorrection procedure (Foxx & Azrin, 1972, 1973). During overcorrection the subject was required to maintain each of three positions for 30 seconds over a period of two minutes: arms folded in front of the chest, hands apart resting on thighs, and hands folded resting on thighs. The order was varied from episode to episode to prevent the subject memorizing the sequence of the exercises. No verbalizations were given during the procedure except the instructions: "You are touching your face!," "Fold your arms," "Put your hands on your legs," and "Fold your hands." In the beginning of the intervention, manual guidance was used to maintain the required position. Any verbalizations by the subject during the procedure were ignored. Except on some occasions when she was absent, all overcorrection procedures were implemented by the author.

Results

Treatment Setting

During the initial baseline period (condition A) the subject engaged in stereotypic behavior during, on the average, 74% of the observed intervals (see Figure 1). The data also show the behavior was variable, i.e., day-to-day changes ranged from a low of 45% to a high of 90% of observed intervals. The intervention during the 20-minute break setting (condition B) dramatically decreased the behavior to a mean of 7% and almost eliminated the variability that was evident during the baseline period. When the intervention was discontinued (condition A) the frequency of the behavior increased to a mean of 54% and regained some of its original variability. Reinstitution of the intervention procedure (condition B) reduced the behavior to a mean of less than 2% (see Figure 1).

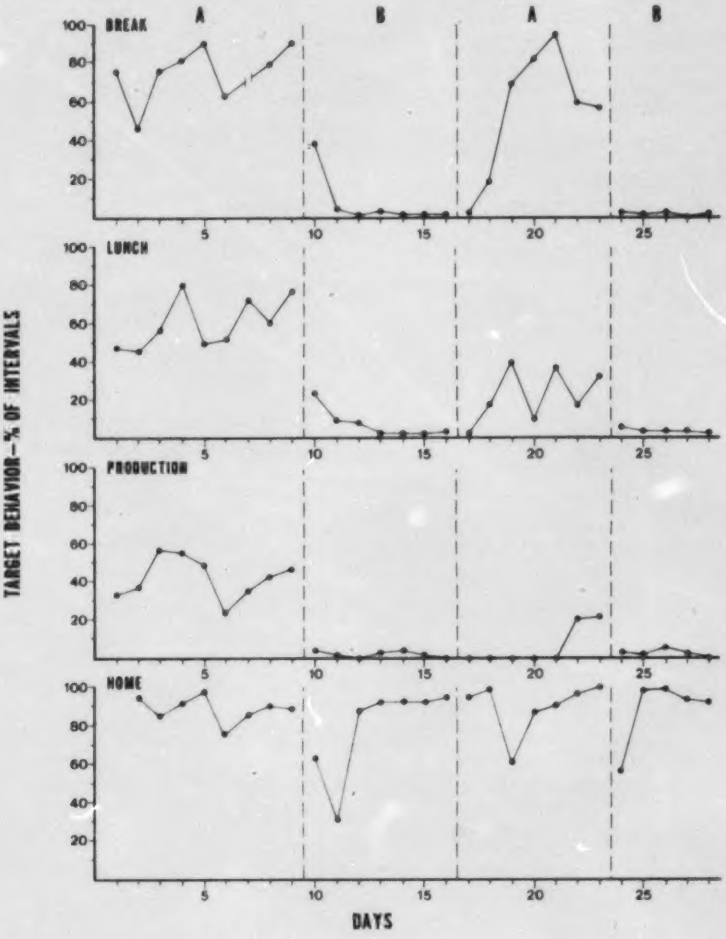

FIGURE 1

Percent of intervals subject engaged in target behavior.

Non-Treatment Settings

During baseline, the behavior had its highest baseline frequency in the home setting, followed by the lunchroom and the production settings. During intervention (condition B) the frequency of the target behavior in the lunchroom and the production setting dropped substantially even though there were no programmed consequences for stereotypic behavior. (From a mean of 60% during lunch to 6.8%, from a mean of 42% during production to a mean of 1.4%.) There was no significant change of frequency in the home setting. When intervention in the treatment setting was stopped (condition A) the frequency began to increase. Again the behavior in the home setting was unaffected. Upon reinstituting the procedure in the treatment setting (condition B) the behavior decreased in all three workshop settings. But again there was no change in rate of stereotypic behavior in the home setting.

Discussion

Clearly, the overcorrection procedure functioned to eliminate the stereotypic behavior of the subject in the treatment setting. This is consistent with other reports that show that overcorrection can bring about significant behavior changes (Foxx & Azrin, 1972, 1973; Azrin, Kaplan, & Foxx, 1973). It is significant that in these previous studies the authors strongly recommend that every instance of the target behavior should be consequated in all settings for maximum treatment effect. But in most applied settings the constraints imposed by such things as staff and time limitations make those recommended procedures extremely difficult, if not impossible, to implement.

The present study attempted to deal with the practical problems imposed by the sheltered workshop and yet still achieve maximum treatment effect across settings. The experimental design employed here clearly indicates a functional relationship between treatment conditions in one setting and changes in behavioral rates in two other non-treatment settings. This is in spite of the fact that out of the normal 6-hour day the subject spent in the workshop setting, only approximately 30 minutes were devoted to treatment. Intervening in just one setting was sufficient to substantially reduce the stereotypic behavior in two extra-treatment settings. This effect, however, is contrasted by the stable rate of the behavior in the home setting throughout the entire study. This discrepancy deserves special consideration. Interestingly, all the workshop settings were very similar in that they shared common characteristics like staff members, physical characteristics of the building, and importantly, they all were highly structured situations. Taken together, these commonalities may have facilitated generalization. If this is indeed the case, it is possible that the workshop setting and the home setting were too dissimilar for generalization to occur. One can speculate that one of the differences between the two environments might be the availability of incompatible behaviors that can be differentially reinforced. Berkson and Mason (1965) and Cleland and Clark (1966) suggest that the frequency of self-stimulating behavior might be controlled by the availability of incompatible behavior. This argument could be supported by the differences in baseline rates in the four settings. The break setting which showed the highest frequency of the behavior outside the home was the least structured of all the other settings in the workshop, at least until the overcorrection procedure was implemented. In contrast, the production room showed the lowest frequency of the target behavior and was the most highly structured. Therefore, a higher number of incompatible behaviors were reinforced, which in turn, may have kept the frequency of the stereotypic behavior at a lower level than in other less structured settings.

A number of further research needs are indicated from the present study. Since, as noted above, it is rarely possible to implement a treatment procedure in every possible situation, specific settings have to be chosen for intervention. Apparently if generalization is the professed goal of a treatment program, the best treatment situation is one that shares as many common elements as possible with other non-treatment situations. How to determine the most critical "common elements" in a particular setting needs further investigation. One might also consider the possibility of intermittently intervening in otherwise non-treatment settings even when consequences are no longer being delivered in the primary treatment setting. In any case, it seems important that outcome measures in non-treatment settings be used to evaluate treatment effectiveness.

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PART III

Related Research

"Operations" in Vocational Training for the Severely Retarded

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Abstract

Severely retarded adults have repeatedly demonstrated their ability to learn difficult vocational skills. Yet, in many sheltered workshops the rapidly changing work and consequent need for frequent retraining may prevent their participation unless training can become more efficient on successive tasks. A possible approach to increasing training efficiency is described which focuses on teaching workers to respond correctly to cues frequently used in vocational training, such as modeling or priming the response, or providing match-to-sample cues. The ability to respond correctly to these cues is conceptualized as an operation or generalized response class, which if taught, might increase the efficiency of subsequent task training. An illustration is provided in which three severely retarded men learned the operation of positioning small parts to match samples. Training techniques relied on differential reinforcement, modeling, and priming of responses to items which varied within a defined range of stimulus features. Acquisition of the operation was assessed by measuring responses to untrained and unreinforced probe tasks. A multiple baseline design across subjects supports the interpretation that the training procedures resulted in acquisition of the defined operation. Future research is proposed to identify efficient methods of teaching this and other operations relevant to vocational training.

"Operations" in Vocational Training for the Severely Retarded

The ability of severely retarded adults to learn a variety of difficult vocational skills is supported by a rapidly expanding research literature (Bellamy, Peterson, & Close, 1975; Crosson, 1966; Gold, 1976; Jacobs, 1976; Martin & Flexer, Note 1). In view of these results, it is not surprising that several authors now advocate for the inclusion of more severely retarded persons in sheltered vocational programs (Bellamy, Note 2; Fox & Karan, 1976; Gold, 1973). However, the episodic nature of work tasks performed in many sheltered workshops may provide a barrier for prospective severely retarded participants. Contracts are often short-lived, with the result that workers are frequently reassigned from task to task. In this situation, the documented ability of severely retarded adults to learn difficult tasks in individual training does not seem sufficient. Also necessary for productive work is an ability to learn a continuing series of new tasks without expensive training periods for each. Therefore, if severely retarded adults are to participate competitively in these vocational situations, ways must be found to increase the efficiency of training on successive work tasks. The purpose of this paper is to describe and illustrate a set of generalized skills, or operations, which may facilitate vocational training.

Completion of a vocational task essentially involves performance of a sequence or chain of responses with the cue for each step being provided by characteristics of the task. Teaching this operant chain is typically accomplished through a process of differential reinforcement in which successive approximations to the desired responses are reinforced only in the presence of specific task-related stimuli. To this differential reinformement process is added a variety of training cues which are intended to augment the task-related discriminative stimuli in order to increase the probability of more acceptable response topographies or discriminations (Bellamy, Inman, & Schwarz, in press). As a trainee begins to perform independently, these training cues are removed as rapidly as possible, so that the task itself provides the only discriminative stimuli for the work behaviors.

Efficiency of training thus results in part from the trainer's ability to provide training cues which are *functional* for the trainee, i.e., which alter the probability of the particular trainee's subsequent responses. Trainers may do this in several ways, including providing verbal directions (Gold & Barclay, 1973), modeling the desired response (Friedenberg & Martin, 1977; Loos & Tizard, 1955), physically priming the trainee through the necessary movements (Hunter & Bellamy, 1976), providing match-to-sample or picture cues (Merwin, 1974; DeBriere, Note 3), or changing properties of the task stimuli (Gold, 1972; Irvin & Bellamy, 1977). With severely handicapped trainees, choice of cue type often depends on an assessment of which type actually increases the chance that the individual will respond correctly. Therefore, one approach to increasing the efficiency of vocational training may be to expand the kind of training cues which are functional for a trainee.

For a training cue to be functional, it must provide a discriminative stimulus which increases the probability that the trainee will perform new responses correctly. The trainee must, therefore, possess a generalized skill of following a particular type of cue with a matching or otherwise appropriate response. A well known example is the generalized imitation skill (Baer, Peterson, & Sherman, 1967) in which trainees imitated new responses for which they received no reinforcement. Becker, Engelmann, and Thomas (1971) have labeled this generalized skill an *operation*. An operation is a set of response characteristics which have a common functional effect and which are under the stimulus control of specific features of a task or setting. Operations are taught by (a) specifying the relevant task and response features; (b) defining the range of situations or tasks in which the operation is to be performed; and(c) teaching tasks which both sample the complete range and provide systematic variation of irrelevant task and response characteristics. Evidence that an operation has been learned is provided when the trainee performs correctly on previously untaught tasks.

The ability of a trainee to match typically used vocational training cues can thus be viewed as an *operation* which can be *taught*. To the extent that severely retarded persons have learned the operations of appropriately following such cues as models, physical primes, verbal directions, and match-to-sample cues, training in vocational skills may become more efficient and participation in community vocational programs more likely. The purpose of the training illustration presented here was to demonstrate and evaluate a procedure for teaching one such operation: the ability to manipulate small parts to match samples.

Method

Subjects

Three severely retarded residents of the Fairview Hospital and Training Center served as subjects. They were ambulatory with no marked physical or sensory deficits and had been institutionalized for an average of 20 years. Subject 1, Joe, was a 28-year old man with a social age of 3.2 years and a social quotient of 11 as measured by the Vineland Social Maturity Scale (1965). He displayed generalized imitation of both motor and verbal behavior and possessed some receptive and expressive language. Subject 2, Tom, was a 26-year old man with a social age of 3.3 years and a social quotient of 12. He displayed generalized imitation of motor behavior, had a limited receptive-language vocabulary and was nonverbal. Subject 3, Pete, was a 26-year old man with a social age of 3.5 years and a social quotient of 15. He imitated neither motor nor verbal behavior, possessed a receptive language vocabulary limited to following simple commands and had some expressive language. All subjects were initially tested to see whether they could perform the sample matching operation. Of the 32 tasks in this pretest, Joe and Pete failed to match any item, while Tom made three correct responses.

Task and Apparatus

Both training and probe tasks required the subject to select an item from a parts bin, place it on a platform so that it matched the position of an identical sample, and then repeat this process with an item in an adjacent bin. The parts bin consisted of two adjacent 7.6 cm square bins, with 5 cm vertical walls on three sides. Extending from the open side of each bin, which faced the subject, was a platform with space for placement of both the sample to be matched and the item placed by the subject. A red dot, approximately 1 cm in diameter, was drawn on the platform in front of each bin to mark where the subject should place each item.

Five sets of small parts items were used to construct training and probe tasks (see Figure 1). *Non-discrimination* items were flat, circular, and identical on both sides (e.g., washers, poker ships). *Up-down* items required the subject to discriminate which of two surfaces faced up. Up-down items were narrow in depth to allow placement only on the top and bottom surfaces, and they were round so that rotational discriminations were impossible. ***Directional*** items were those which could be matched only with respect to their rotation in a horizontal plane (e.g., a nail with the head pointed toward the subject). *Two-dimensional* items required the subject to utilize both up-down and directional dimensions in making a correct match. ***Assembly*** items consisted of a pair of items that were assembled out of the sight of the subject and placed together as the sample. The subject had to pick up both items from the bin and assemble them so that they matched the preassembled sample. Training tasks and probe tasks were defined using different items from each of the up-down, directional, two-dimensional and assembly sets.

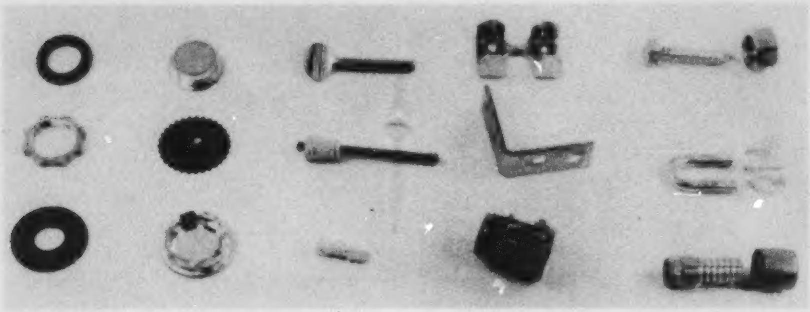

FIGURE 1

Illustrations of Parts Used to Construct Training and Probe Tasks

General Training Procedures

Subjects were seen individually during 30- to 40-minute sessions, once daily, approximately three times per week over a 2-month period. An effort was made to provide training for all three subjects on any day that training sessions were conducted. Due to scheduling difficulties, however, there were some instances in which only one or two subjects were trained on a given day. Sessions were conducted in an upstairs dormitory room away from the living area. The experimenter and subject sat beside each other at a small table upon which the bin apparatus was placed.

A task was presented with the instruction, "(name), make it look like this," with the experimenter pointing to the sample in front of the left-hand bin. If the subject responded correctly, he was praised and then given the same instruction with a gesture to the right-hand bin. When both items had been correctly positioned, the subject was reinforced with both praise and edible treats. Responses to initial tasks of a session were reinforced on a continuous basis. This was faded to an intermittent schedule after the subject was generally attending and performing correctly.

If the subject incorrectly positioned an item and/or failed to place it in front of the corresponding sample, the correct response was modeled several times along with a verbal statement concerning the salient features of the sample. The subject was then given another opportunity to respond. Subsequent errors were corrected by returning the item to the bin and physically guiding the subject in positioning the item correctly.

Non-Discrimination Training

Subjects were first trained to match the position of non-discrimination items. In this phase the subject correctly matched the position of the sample by placing the item on the platform. Non-discrimination training served to familiarize the subject with the procedure of selecting an item and placing it on the correct dot and as a baseline control for subsequent training procedures. An item remained in the same bin and in the same position for four or five consecutive trials after which it was removed and replaced with another item. The next time that item was presented it was placed in the opposite bin.

Discrimination Training

Following a multiple baseline design across subjects, training on the sample-matching operation with the *up-down* items was provided first to Joe, then Tom, and finally, Pete. Training procedures were like those used with non-discrimination items, with the subject responding alternately to the two tasks in the bin setup. Each task remained in the bin for six responses or until the subject correctly matched the sample three consecutive times. The item was then replaced by another task, and was later used again with the sample positioned differently.

After the first five training sessions it appeared to the experimenter that these procedures could be teaching two unwanted operations which were incompatible with the sample-matching response. First, Joe appeared to be responding to some items as if a particular side always went up, regardless of changes in the position of the sample. The procedures were therefore changed to allow more frequent changes in the position of each sample and more frequent alternation among tasks. The subject was then asked to respond only once to each item before it was replaced or the position of its sample changed.

A second incompatible operation appeared to result from the position of items in the bins before each response. During initial training sessions, the item was placed in the bin so that some rotation was necessary to match the position of the sample. After several responses, subjects began turning many of the items over before placing them on the dot, regardless of the sample position, presumably because this had led to a correct match on previous tasks. Thus, the experimenter began randomizing the position of the item in the bin so that it was the same as the sample on approximately half the trials and in the opposite position on the remaining trials. This appeared to be successful in overcoming the competing operation of simply "flipping" each item. Both procedural changes were simultaneously incorporated into the nondiscrimination training procedure for Tom and Pete.

Probe Procedures

Acquisition of the sample-matching operation within the stimulus range defined by each set of items was assessed by measuring performance on untrained and non-reinforced (probe) tasks. Thirty-two probe tasks were constructed, eight each from the up-down, directional, two-dimensional and assembly sets. The position of each sample was randomly determined before each probe sequence.

Probe items were first presented during a pretesting session. Thereafter, all were presented near the end of each training session by randomly interspersing them among the trained items. Subjects continued to be reinforced for correctly matching the trained items but no reinforcement was given for correctly matching a probe item. On some occasions up to four probes occured successively, thereby reducing the reinforcement density. At these times the subject was praised for paying attention and remaining seated after the items had been removed from the bin setup and just prior to the introduction of a new pair of items.

A task was scored as correct if the required matching response occurred within 10 seconds of the direction, "(name), make it look like this." Matching responses were correct if the appropriate surface of an up-down item was visible; if the rotation of a directional item differed less than 20° from the sample; if a two-dimensional item met the criteria for both up-down and rotational items; and if assembly items were put together in exactly the same manner as the sample.

Once during each phase, an additional observer independently recorded each subject's responses to all 32 probe tasks. In every case agreement between the two observers was perfect, reflecting the ease of recording matching responses.

Additional Training Phases

Discrimination training on the up-down items continued until each subject acquired a sample-matching operation across some item sets. When the operation was restricted to items similar to those being reinforced during training, or to some other subset of probe items, the subject was trained to match additional classes of items. This training began with directional items and continued until the operation was performed correctly across the entire range of probe tasks. To maintain correct responding on previously taught sets of tasks, items not used in probes were occasionally presented and correct responding reinforced.

Results

Probe data for each subject are presented in Figure 2. Each point represents the total number of correct probe responses within each set. The vertical dotted line that bisects every subject's data indicates when the experimenter began changing the position and bin placement of the sample on each trial. The "A"s at the bottom of each graph represent days when training did not occur for that subject.

During non-discrimination training, the number of correct probe responses remained at pretest levels. Joe did not correctly match any of the probes. Tom and Pete matched several probes but their performance was inconsistent. With the introduction of up-down discrimination training, where the sample remained constant over several responses, Joe began matching several of the up-down probes but very few of the probes within the remaining sets. His performance, however, appeared to be one of randomly "flipping" some items but not others thereby leading to some correct responses. When discrimination training procedures were revised so that the position and bin placement of the sample was changed after each response, Joe began matching probes within all four probe classes. After 15 training sessions, Joe correctly matched all 32

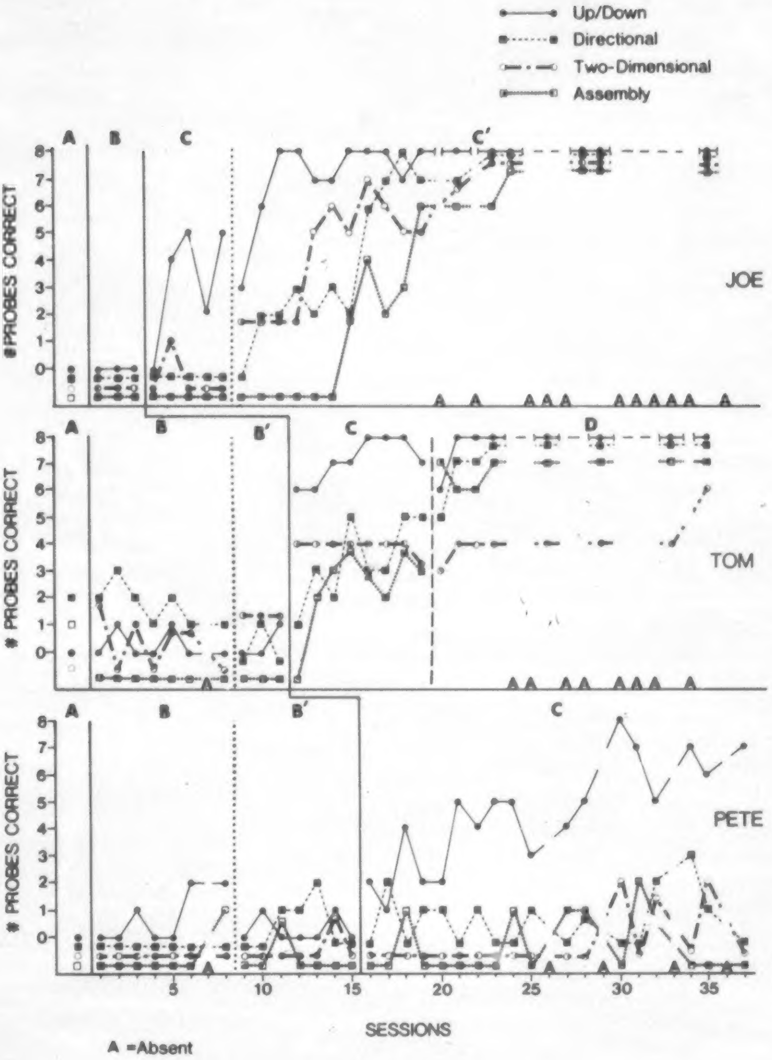

FIGURE 2

Number of correct responses to probes conducted during (A) pretest; (B) training on non-discrimination tasks, (C) training on up-down tasks; and (D) training on directional tasks. Probes conducted after training procedures were revised are marked B′ and C′.

probes and maintained this level of performance over the next four sessions.

Even though the samples were changed after each response in non-discrimination training, Tom and Pete showed no comparable change in performance until up-down discrimination training was introduced. With the introduction of the revised discrimination training procedures, Tom also displayed an immediate increase in correct probe responses. Unlike Joe, however, generalization of matching responses appeared more restricted to the class of probes containing items similar to those being concurrently trained. After five sessions, Tom correctly matched all eight of the up-down probes on all subsequent training sessions except two. When only up-down items were being trained, the average number of correct responses on directional, two-dimensional and assembly probes was 3.38, 3.88 and 2.62, respectively. When training on directional items was introduced, and a maintenance procedure applied to previously learned up-down items, Tom displayed an immediate increase in correct matching of both directional and assembly probes. The number of two-dimensional probes correctly matched remained the same until the last training session at which time Tom matched six of the eight probes within this class.

When discrimination training began for Pete, some generalized matching was observed for up-down probes alone. During non-discrimination training, Pete correctly matched an average of 0.47 up-down probes. This average increased to 4.50 over 18 training sessions. Little generalization occurred across the remaining probe classes. Subsequent training for Pete did not take place due to increasing belligerence and refusal to accompany the experimenter into the training area. This was interpreted as behavioral evidence that informed consent was being withdrawn, and the training program was terminated.

Discussion

The results from the first two trainees provide evidence that the ability to follow a typically used vocational training cue is an operation which can be taught to severely retarded adults. Furthermore, the development of this operation was functionally related to the specific training procedures used. Generalization of matching responses to untrained and unreinforced probes only occurred after trainees were required to respond to the stimulus configuration of the sample's position on the platform by emitting whatever manipulations were necessary to match that position. Other stimulus and response characteristics of the task, such as the bin setup and the actions of selecting an item from the bin and placing it on the platform, were not functional in developing the operation since they were all present in non-discrimination training.

Although the teaching procedures described here were effective in developing the sample-matching operation, a question still remains as to the most efficient method of teaching this, and perhaps similar, operations. As was noted above, the procedure was modified in the present study because of the experimenter's hypothesis that more rapid acquisition might be obtained if the tasks were changed more frequently and the items positioned in the bins in a random fashion. Of course, no data are available here to evaluate whether this change did result in more rapid acquisition. Continued research is needed to evaluate the relative efficiency of these and other procedural variations.

Future research should also focus on the effects which various training procedures have on the range of resulting operations. As in generalized imitation, some procedures may produce operations which are performed only in response to a limited range of controlling stimuli (Garcia, Baer, & Firestone, 1971). It would appear that vocational training on new and changing tasks would be more efficient if a wide range of potential training cues functioned as discriminative stimuli for a particular operation. In the present study teaching the operation with one class of cues was sufficient to establish the operation across other, quite diverse, classes of cues for one of the trainees, but it was insufficient for the other two. Research is needed that will identify the optimum characteristics of training stimuli which will establish operations that are controlled by the full range of potential training cues.

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Utility of an Instrument for Assessing Labels Used to Describe Retarded Adults

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Abstract

The Becker Adjective Checklist was used by residential caretakers to assess moderately and severely retarded adults. Factor and score stability analyses were performed using measures derived from a simple and practical system for scoring. Results suggested that the instrument may be a useful tool for evaluating labeling behaviors of important others in the lives of retarded persons.

Utility of an Instrument for Assessing Labels Used to Describe Retarded Adults

The current expansion of services for severely retarded individuals is consistent with widely held professional beliefs that a more normal, more qualitative lifestyle is possible for them. An approach to evaluating these services, therefore, is to ask whether they result in measurable improvements in individual lifestyles. Such an evaluation will require operational definition of desired outcomes and should involve use of several measurement methods to evaluate progress toward these outcomes (Campbell & Fiske, 1959; Johnson & Bolstad, 1973).

One criterion that may be of interest in evaluating programs is the extent to which changes occur in the labels with which a retarded individual is described by important persons in his or her environment. While such labels are not necessarily accurate reflections of actual behavior they nevertheless may be important measures of individual progress. From a sociological perspective, deviance or retardation may be defined by the labeling behaviors of important persons in the environment (Mercer, 1973; Ullmann & Krasner, 1969). Different labels may also result in differential treatment in potential learning situations (Beez, 1968; Meichenbaum, Bowers, & Ross, 1969; Rosenthal & Jacobson, 1968).

This paper evaluates the possible utility of one instrument for assessing these labeling behaviors: an adjective checklist developed by Becker (1960). Originally designed for use by parents or teachers of young children, the checklist consists of pairs of bipolar adjectives, with the adjectives in each pair defining the extremes of a seven-point rating scale. Points on the scale are labeled with the numerals —3 to +3, with algebraic sign having no clear relationship to social desirability. Seventy-two adjective pairs were used in the original research (Becker, 1960), but only 47 pairs were used in a later factor analysis by Patterson and Fagot (1967). A scoring system based on the Patterson and Fagot (1967) research has been used in evaluating the effectiveness of several family intervention programs designed to ameliorate behavior problems of young children (Johnson, Christensen, & Bellamy, 1976; Patterson, Cobb, & Ray, 1973).

The purpose of the present study was (a) to describe the factor structure of the Becker adjective checklist when it was used by residential caretakers to rate moderately and severely retarded adults; (b) to evaluate a simple system for scoring the checklist which resulted in scores based on the factors; and (c) to assess the stability of these scores over an extended time period like that which might be of interest in program evaluation research.

Method

Moderately and severely retarded adult residents of a large state hospital were rated by residential caretakers using the 47-adjective pair form of the Becker adjective checklist. Ratees were selected without known bias from individuals in six living units who were present during daytime hours and were therefore potential subjects in vocational training research. Raters were residential care aides who were regularly scheduled in a ratee's living unit. A total of 606 completed checklists were obtained, with 102 raters and 518 ratees participating.

In a second rating period after a lapse of one year, 214 completed checklists were obtained, one from each of the rater-ratee combinations which still existed in the six living units, given resident movement and staff attrition.

Each checklist was completed by the aide reported to have the best knowledge of the ratee. The rater's attention was called to written instructions which asked that behavior be evaluated relative to potential "peers in a sheltered community living or activity center." No verbal explanations were given concerning possible interpretation of the adjective pairs.

Results

Intercorrrelations among the 606 ratings on the 47 adjective pairs were factor analyzed using a varimax procedure for orthogonal rotation. Five factors with eigenvalues greater than one resulted, and these were labeled Withdrawn, Disruptive, Incompetent, Tense, and Non-Compliant. Adjective pairs with either positive or negative loadings greater than .45 on each factor are listed in Table I. Also indicated in Table I are the items which load above .45 on similarly labeled factors obtained by Patterson and Fagot (1967) and Becker (1960). Parents' ratings of young children were used in the Patterson and Fagot (1967) analysis, and parents' and teachers' ratings of preschoolers were used by Becker (1960). As is apparent in the table there is considerable agreement with both previous factor analyses.

A scoring system similar to that used by Patterson, Cobb, and Ray (1973) was developed to derive easily computed scores based on the five factors. Ratings (+3 to −3) on each item with a factor loading above .45 were additively combined, with sign changes which were appropriate for consistency of meaning within factors. Ranges and distribution of the resulting scores are presented in Table II for the 214 rater-ratee combinations from whom data were obtained in both the first and second rating periods. The correlations between total scores on each factor for the first and second test are also presented in Table II. These range from .536 to .755 and are all significant beyond the .001 level. The checklist and scoring system thus result in scores which are relatively stable across time, when stability is defined in terms of relative position of individuals within a group.

Discussion

The results of this factor analysis and scoring evaluation suggest that the semantic differential developed by Becker (1960) may be a useful instrument for evaluation of programs for severely retarded persons. Of course, its use is suggested as a supplement to other rating scales and behavior observation instruments, consistent with a multiple assessment strategy (Campbell and Fiske, 1959). Factors which emerged from the analysis were strikingly similar

Table I

Items loading above .45 on each of 5 factors

I Withdrawn	
Sociable-Unsociable*†	(.789)
Warm-Cold*†	(.826)
Happy-Depressed*†	(.755)
Responsive-Aloof*†	(.733)
Loving-Not loving*†	(.775)
Colorful-Colorless*†	(.670)
Extroverted-Introverted*†	(.619)
Interesting-Boring*†	(.606)
Optimistic-Pessimistic*†	(.541)
Trusting-Distrusting*	(.563)
Bored-Interested†	(.486)

II Disruptive	
Demanding-Not demanding*†	(.711)
Prone to anger-Not prone to anger*†	(.745)
Jealous-Not jealous*†	(.613)
Prone to tantrums-Not prone to tantrums*†	(.714)
Impatient-Patient*†	(.661)
Irritable-Easy going*†	(.647)
Strong willed-Weak willed	(.572)
Dominant-Submissive	(.643)
Adventurous-Timid	(.568)
Tough-Sensitive	(.560)
Noisy-Quiet	(.570)

III Incompetent	
Dull minded-Intelligent*†	(.792)
Subject to distraction-Able to concentrate*†	(.602)
Ineffective-Effective*†	(.717)
Poor memory-Good memory*†	(.729)
Meaningless-Meaningful*†	(.700)
Slow-Quick*†	(.555)
Subjectively inferior-Self-confident*†	(.621)
Independent-Dependent	(.488)

IV Tense	
Tense-Relaxed*†	(.720)
Nervous-Placid*†	(.766)
Excitable-Calm*†	(.695)
Emotional-Objective*†	(.585)
Anxious-Nonchalant*†	(.663)
Fluctuating-Stable*†	(.474)
Fearful-Not fearful*	(.463)

V Non-Compliant	
Responsible-Irresponsible†	(.643)
Obedient-Disobedient*†	(.567)
Cooperative-Obstructive*†	(.554)
Easily disciplined-Difficult to discipline*†	(.510)
Organized-Disorganized	(.688)
Helping-Not helping*†	(.525)
Adult-like-Infantile†	(.551)
Neat-Disorderly†	(.639)

* Item loads on similarly labeled factors in the Patterson & Fagot (1967) analysis.
† Item loads on similarly labeled factors in the Becker (1960) analysis.

Table II

Comparison of scores obtained during the two rating periods

	Factor I	Factor II	Factor III	Factor IV	Factor V
Mean, Time 1	1.19	0.250	2.88	3.86	1.19
Range, Time 1	-21 to 24	33 to 29	19 to 24	-21 to 21	-21 to 24
Standard Deviation, Time 1	10.13	14.13	8.69	8.50	10.13
Mean, Time 2	8.00	0.94	0.05	2.85	1.18
Range, Time 2	-33 to 29	33 to 32	-19 to 24	-17 to 21	-24 to 24
Standard Deviation, Time 2	12.08	13.76	7.87	7.[illegible]	8.81
Correlation, Time 1 and Time 2	.65*	.78*	.54*	[illegible]4*	.60*

*P < .001
N = 214

to those obtained previously by Patterson and Fagot (1967) and Becker (1960) with quite different populations of raters and ratees. This similarity supports the conclusions of Passini and Norman (1966), who found that factor structures were relatively stable across other instruments used to rate individual characteristics, in spite of extreme differences in the relationships between raters and ratees.

The additive scoring system used in the present analysis provides a simple method of hand scoring the checklists. The five scores which result are based on the instrument's factor structure and appear relatively stable over extended time periods. Changes in these scores during or following program involvement would indicate a general change in the labels used by others to describe a severely retarded person.

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Evaluation of a Procedure for Teaching Generalized Tool Use Skills to a Severely Retarded Person

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Evaluation of a Procedure for Teaching Generalized Tool Use Skills to a Severely Retarded Person

The successful participation of some severely retarded adults in sheltered work programs has raised the possibility that important training in prevocational skills might be provided in public school secondary programs (Bellamy, Inman, & Horner, in press; Gold, 1976; Brown, Bellamy & Sontag, Note 1; Karan, Wehman, Renzaglia, & Schutz, Note 2). However, the specific tasks available to sheltered workshops require a variety of response demands and are often available on unpredictable schedules. Therefore, the utility of much prevocational training for the severely retarded will depend on the extent to which students acquire generalized skills which are relevant in a variety of specific job settings.

The importance of generalized skills has long been recognized in prevocational and work adjustment programs for less severely handicapped individuals (Brolin, 1976). Behaviors like promptness, grooming, personal hygiene, and social relationships, which are important regardless of specific job demands have typically been the focus of instruction. An additional approach to teaching generalized skills seems appropriate for the severely retarded, who are often deficient in specific job skills as well. In this approach common skill requirements of several jobs would be identified and taught in an effort to facilitate later acquisition and performance of jobs which involved the skill.

One such common skill requirement of many vocational tasks is the use of hand tools. Prevocational training in the use of a tool to complete a specific task could be useful, if the student obtained stable employment performing that particular task. The student's skill would seem more versatile, however, if the tool could be used to complete a variety of tasks which differed in stimulus characteristics and exact response requirements. Such a generalized skill should reduce the training required to teach an individual any new task requiring the use of the tool and should thus enhance the individual's vocational competence.

Because of their emphasis on teaching skills which generalize across several specific tasks, the programming approach of Becker, Engelmann and Thomas (1975) seems well suited to prevocational training. They identify two types of generalized skills. The first involves performance of a skill in spite of variation in the stimulus situation (teaching a concept); the other involves performance in spite of variation in exact response characteristics (teaching an operation). The irrelevant variation in each defines the range of the generalized skill. Programming concepts and operations involves identifying and sequencing specific tasks which sample the range across which generalization is desired. In either case, the generalized skill has been learned when the student responds appropriately to untaught tasks that fall within the defined range.

The purpose of this study was to investigate the utility of the Becker, Engelmann, and Thomas (1975) programming approach in prevocational training. A generalized tool use skill, use of a socket wrench set for benchwork disassembly, was programmed through the selection of training tasks that sampled a defined range of stimulus and response variation. Acquisition of the generalized tool use skill, as evidenced by correct performance on untaught tasks, would lend support to this programming strategy in prevocational training situations.

Method

Subject

The subject was a thirty-three year old Down's Syndrome man labeled profoundly retarded on the basis of scores from the Standford Binet and Adaptive Behavior Scales. At the time of this study, the subject was employed at a subcontract shop providing vocational training for severely handicapped adults. He had been at the shop two years, two months and was residing in a group home with fellow employees through the period of employment. Prior to this he lived in a state institution for twenty-one years. The subject had no motor or sensory impairments and was able to imitate trainer behavior. He had very limited expressive and receptive language ability.

Task and Apparatus

The apparatus consisted of a socket wrench set, six tasks which required the use of the socket wrench, and data sheets for recording the subject's responses. The socket set was an eleven-piece ⅜ in. drive model distributed by G. L. Company, Inc. The sockets were arranged from largest to smallest in a plastic tray, and the ratchet was located on the tray parallel to the row of sockets.

The six tasks consisted of using the socket set to loosen and remove nuts or bolts from different pieces of equipment. Table 1 provides the 29 steps used in all six tasks. The tasks were specifically designed to sample a predefined

Table 1

29. Raise hand
28. Place ratchet in holder—peg down
27. Place socket in box
26. Separate ratchet & socket
25. Hold ratchet in one hand—socket in other
24. Pick up ratchet in one hand—socket in other
23. Place nut in bin
22. Rotate nut in counter—clockwise direction until off bolt
21. Pincher grasp nut
20. Reach for nut
19. Place ratchet & socket on side of jig
18. Lift ratchet & socket
17. Turn ratchet back & forth until teeth no longer sound
16. Hold wood base with left hand
15. Rotate and depress until socket fits
14. Place starred end of socket over nut
13. Lift ratchet & socket
12. Rotate & depress ratchet until fits into socket
11. Place ratchet over square hole in socket
10. Hold socket with free hand
9. Pick up ratchet—peg end down

Table 1 (Continued)

8. Reach for ratchet
7b. If no turn—place socket in front of task on dot
7a. If socket turns place aside—return to step 2
6. Rotate with hand
5. Place starred end over nut
4. Pick up socket
3. Pincher grasp socket
2. Reach for largest socket
1. Orient to task

range of possible behaviors and discriminations involved in the use of a socket set for disassembly. Characteristics that varied across at least two tasks included (a) whether the task involved the removal of a nut or bolt; (b) the size of the nut/bolt, i.e., the size of the socket used for each task (step 7 of the task analysis, see Table 1); (c) location of the nut/bolt on the apparatus, determining the behaviors required for placement and turns of the socket wrench (steps 5 and 14 of the task analysis); and (d) number of times the ratchet was turned by hand (step 17 of the task analysis), A description of each task is presented in Table 2 in the order of training. The task order was randomly determined prior to training. Completion of each task involved performing, in sequence, a chain of behaviors which was broken down into 29 steps, or discriminated operants (Crosson, 1967).

Table 2

DESCRIPTION OF TRAINING TASKS
IN THE ORDER OF INSTRUCTION

Task 1: Remove a ⅜" nut from a bolt embedded vertically in a flat piece of wood, with an average of four complete turns of the ratchet.
Task 2: Remove a 9/16" nut from a bolt on the underside of an overhanging piece of wood, with an average of two complete turns of the ratchet.
Task 3: Remove a ¾" bolt from a nut embedded in a flat piece of wood, with an average of one-quarter turn with the ratchet.
Task 4: Remove a 7/16" nut attached to a bolt protruding from the right side of a wooden block, with an average of three complete turns with the ratchet.
Task 5: Remove a ½" nut from a bolt embedded vertically within an opening 2" in diameter in a flat piece of wood, with an average of three and one-quarter turns of the ratchet.
Task 6: Remove a ½" nut from a bolt embedded in a piece of wood slanted at a 30 degree angle, with an average of four complete turns with the ratchet.

Data Collection

Training data and pretraining probe data were collected on a form adapted from Saunders and Koplik (1975), which allowed the trainer to record performance on individual steps as well as to maintain a continuous record of task acquisition. A step was recorded as correct only if it was completed accurately without assistance from the trainer.

A second data sheet was employed to record the number of tasks completed correctly on daily probes. During daily probes each complete task was scored as correct only if all 29 steps of the task were completed independently and accurately. Observer agreement data were collected by positioning the second observer on the opposite side of the subject from the trainer so that neither the trainer nor the observer could see the others records. The observer and trainer scored the subject's response for each step of all six tasks during that day's probes. Reliability was computed by dividing the total number of steps scored the same way by the total number of steps attempted. Reliability data were collected at one week intervals for four weeks. Inter-observer reliability was 100% on each occasion. Because of the simplicity of the response and the high reliability scores, reliability data were collected on only one additional occasion two weeks later. Again, inter-observer agreement was 100%.

Design

Components of a multiple baseline design were used (a) to determine whether training procedures were functionally related to acquisition of specific task skills, and (b) to assess the extent to which training on some tasks was correlated with improvements on untaught tasks. Each task was taught to a criterion before instruction on the next task in the sequence was begun. Two kinds of probes were used to assess skill development on each task prior to training. Pre-training probes, which occurred at the outset of the study and immediately before instruction on each task, indicated the number of steps the subject could do correctly without training. Daily probes, which occurred at the end of each training session, assessed the subject's performance of each of the six tasks.

Since the experimental control required for inferring functional relationships implies a different result from the acquisition of generalized skills, the following outcomes were expected: Independent and correct performance on each of the first two or three tasks would occur only after training procedures had been implemented for that task, although some improvement on all tasks was expected as a result of any training. Further, tasks which were quite different from those taught previously in response or stimulus characteristics (e.g., Task 4) also were expected to be performed accurately only after training. These results would provide evidence for a functional relationship between training procedures and specific task acquisition. If later tasks in which the required discriminations and behaviors fell within the range of previously taught tasks were performed with little or no training, evidence for the acquisition of the generalized tool use skill would be provided.

Training Procedures

The subject was seen approximately one hour, five days a week, over a two and one-half month period. Training was conducted on one task at a time until four of five consecutive trials were completed without error or assistance. The subject was seated at a workbench with the task before him and the trainer seated beside or standing behind him. When the subject was attending to the task, the trainer modeled the first step, asked the subject to perform the step, and provided differential consequences for correct and incorrect responses. Correct responses were followed by short verbal praise and the opportunity to perform the next step. The subject was stopped immediately after an incorrect response. The trainer returned the task to the last correctly completed step and, through modeling, prompting or physical priming, provided assistance to the subject to ensure correct performance of the step. This correct performance was reinforced and the trainer again returned the task to the last correctly completed step. The subject was given the opportunity to perform the step again with less trainer assistance.

This procedure was used as each new step was introduced in sequence. As training progressed, the trainer gradually faded prompts and physical assistance so that the subject was expected to complete each step without aid during later stages of training on each task. The density of verbal reinforcement was also faded to an intermittent level as the subject became more proficient at each task. Throughout training, the subject was given one penny upon completion of each task which could be exchanged for edibles in a store operated as part of a shop-wide token economy.

Tasks previously trained were reviewed once at the beginning of each training session if any step had been missed on the previous day's probe. Review procedures were similar to those employed during actual training, except that the trainee was given several practice trials on any step which was performed incorrectly.

Probe Procedures

Prior to training on each task, performance was assessed during two kinds of probe trials. Pre-training probes were administered on all six tasks both prior to the initiation of all training as a baseline measure and immediately before training on each task. All probes were administered at the end of each daily training session and were presented in order, Task 1 through Task 6. At the outset of each probe, the subject was told, "Take off the nut/bolt." The trainer did not point to the task or in any way identify the location of the nut/bolt. If an error occurred during a pre-training probe, the trainer scored that step as incorrect and then completed the step, thereby providing the discriminative stimulus for the next step. This procedure allowed the subject to complete all 29 steps in the task. If an error occurred on the daily probes prior to training, the trainer scored the entire task as incorrectly completed, replaced the socket set to its original position, and presented the next task. This procedure was employed to avoid the possibility of a modeling effect upon acquisition outside of training. In both cases, the trainer allowed the subject five seconds to perform each step correctly before scoring a response as incorrect. Throughout the probes the trainer supplied intermittent praise for working hard, attending to the task, trying, and other appropriate work behaviors. Praise was not contingent on correct responding.

Results

Figure 1 illustrates the subject's performance on each task during probes prior to training as well as performance during training. In the first pre-training probe, the subject performed 3 of 24 responses correctly on Tasks 1, 2, 3, and 4; 7 on Task 5; and 6 on Task 6. During the second pre-training probe on Task 1, the subject performed 22 steps correctly. This increase without training was attributed to the subject's learning of responses by observing the trainer complete each step during earlier probes. A similar imitation effect could account for the larger number of correct responses in the initial probes on Tasks 5 and 6, which followed all other probes.

Training on Task 1 required 17 trials before the 4 criterion trials were performed. During training, errors were confined primarily to Steps 5, 17, and 28. No correct responses to other tasks were recorded on daily probes while Task 1 was being taught.

On the second pre-training probe on Task 2, the subject performed 20 steps correctly, not unlike the number performed on Task 1 immediately prior to training. Training required 68 trials before the criterion was met, with errors occurring primarily on Steps 13, 15, 17, and 28. As soon as training on Task 2

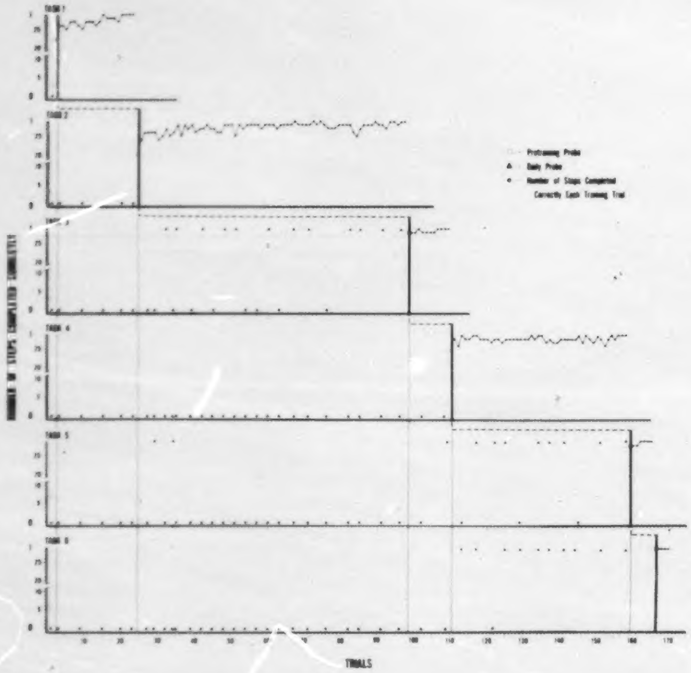

FIGURE 1

Number of steps completed during Pretraining, Probes, and Training trials. The number of times the 29 steps were completed for each task during daily probes.

was begun, the subject began performing perfectly on some probes on Tasks 3 and 5 on which performance had never been reinforced. Correct performance on Task 5 occurred on only 2 days, but it persisted on Task 3, so that performance was perfect on four consecutive days before training on Task 3 was initiated.

Although these probes had been correct, the subject did miss Step 28 in the pre-training probe on Task 3 and required seven training trials before meeting the training criterion. During the two days required for this training, probes on Tasks 4 and 6 remained consistently incorrect. An additional correct response on Task 5 was recorded, however.

Twenty-five steps were completed correctly on the second pre-training probe on Task 4. Errors persisted on Steps 15 and 17 during 43 training trials before the criterion response was recorded. During this time, correct responses to probes on both remaining untaught tasks increased dramatically. Prior to training, Task 5 had been performed correctly on 9 of the last 12 probes. Training required only two trials before the criterion. Task 6 required no training.

Discussion

To the extent that flexible job skills are required by fluctuating contracts in sheltered workshops, prevocational training programs should seek to teach skills that can be applied to a variety of tasks. The results of this study suggest that the programming approach described by Becker, Engelmann, and Thomas (1975) may be an effective strategy for teaching such generalized skills. After training on some tasks requiring use of a socket wrench the subject performed correctly on other untrained tasks which required that different discriminations and responses be made to achieve the same result. He thus learned the generalized skill, or operation, of using a socket set to remove a nut or bolt.

Use of the socket wrench would be a specific skill if the worker only learned to perform the 29 steps when required by a specific task. If new tasks with the same basic outcome (e.g., removal of a nut), but different stimulus characteristics and different response requirements, were similarly performed without trainer assistance a generalized tool use skill (or operation) would have been learned.

Analysis of the data in Figure 1 from the first three tasks indicates that considerable training was required before the subject reached criterion on Tasks 1 and 2, but not Task 3. Task 3 not only required very little training, but was being performed correctly with a high degree of consistency before training began.

Training procedures appear functionally related to acquisition of the skills necessary to perform Tasks 1 and 2. Task 3 data, however, suggest that the skills learned from Tasks 1 and 2 generalized across the unique stimulus and response requirements in Task 3. This is not surprising given the high degree of similarity between Tasks 1 and 3.

The accurate performance on Task 3 prior to training is exactly what would be anticipated if the subject had learned the operation "use of a socket wrench to remove a nut or bolt." If the operation had become truly functional, however, it would be expected that performance on Tasks 4, 5, and 6 would be similar to that of Task 3. That is, after training on Tasks 1 and 2 all the tasks would be performed correctly. This result is not indicated by the data. When training on Task 2 began, there were only two probes in which Task 5 was performed correctly, and no indication that the skills acquired in training were affecting performance on Tasks 4 and 6. The fact that Tasks 1, 3, and 5 all required removal of a nut or bolt from a flat surface suggests that task similarity may have been somewhat related to improved performance on Tasks 3 and 5. Generalization did not occur, however, until after training on Task 2 began. The design of the present study does not allow analysis of whether generalization would have occurred if training on Task 2 had not commenced.

Task 4 was the only task requiring nut or bolt removal from the side of a vertical surface. Considerable training was required before criterion on this task was met. Soon after training on Task 4 began, both Task 5 and Task 6 were performed correctly on most probes. Negligible training was required on Tasks 5 and 6 to meet the acquisition criterion. This suggests that the skills learned during training on the first four tasks generalized across the novel stimuli and response topographies of Tasks 5 and 6. This result holds special interest given the unique angle of nut removal in Task 6. Task 6 required positioning and rotation responses markedly different from those the subject had previously encountered. As such, these data argue that, within the response range defined by Tasks 1 through 6, the operation "using the socket set to remove a nut or bolt" had in fact been learned.

Figure 1 data indicate that generalization of skills occurred both soon after training on Task 2 began, and soon after training on Task 4 began. One possible explanation for the two points of generalization is that generalization was a function of both similarity of novel tasks to trained tasks, and number of tasks previously trained. Skills learned in one task may generalize to a similar task after training on only one or two tasks, while generalization to dissimilar tasks may require training on several tasks with varying stimulus and response characteristics. This interaction would suggest that when teaching an operation several tasks with similar outcomes but varying response topographies be used. The tasks should be selected to sample the full range of response topographies which define the operation.

The present study is somewhat limited by a high degree of similarity across the six tasks. Future analysis of operation development can build on the present data by using response instances of an operation that are more dissimilar than those found in Tasks 1 through 6. Clearly the vocational viability of teaching concepts and operations lies in accurate performance across a variety of tasks or situations being facilitated by training on just some of those tasks or situations. The present data indicate that the number of trained instances and the diversity of those instances may affect the extent to which the acquired skills will generalize. Further research with these variables is clearly warranted.

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Long-Term Retention of Vocational Skill Training by Severely Retarded Individuals

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Long-Term Retention of Vocational Skill Training by Severely Retarded Individuals

The powerful effects of various training strategies on acquisition and transfer of vocational skills by severely retarded individuals have been demonstrated in increasing detail (Bellamy & Irvin, 1976; Gold, 1972, 1974; Gold & Barclay, 1973a, 1973b; Irvin & Bellamy, 1977). Scant attention has been focused, however, on the effects of such training procedures on long-term retention/relearning of vocational skills by severely retarded persons.

The research described here was designed to investigate the effects of stimulus features manipulation training strategies, like those employed by Gold (1972, 1974) and Irvin and Bellamy (1977), on severely retarded individuals' long-term retention/relearning of vocational skills. Gold (1972) set the stage by demonstrating that when redundant stimulus color cues were present on bicycle brake assembly tasks during original acquisition training *and* during one-year maintenance probes, the retention/relearning performance was clearly superior to original acquisition performance. Irvin and Bellamy's (1977) work demonstrated some of the conditions under which different stimulus manipulation training strategies produce differential acquisition of vocational skills. The current research was designed to investigate two questions that arise from the results of these two studies: (a) do different stimulus manipulation training strategies produce differential skill retention/relearning effects; and (b) is retention/relearning efficient when all redundant training cues are removed from the relevant stimulus dimension(s) of the criterion task during the maintenance probe?

These two issues gain particular importance when their implications are examined for prevocational skill training and for the transition severely retarded individuals must make from acquisition to production of vocational skills. Gold's (1972) retention findings demonstrated that one-year retention without practice of learned vocational skills by severely retarded individuals occurs when redundant training cues are present during the retention exercise and when acquisition to a rigorous criterion has been previously accomplished. Because production settings are less likely to provide powerful redundant cues than are training settings, it is important to examine retention effects in the absence of such cues. In addition, unless retention across time can be demonstrated, prevocational training on vocational skills serves no purpose in settings where no immediate opportunity exists to employ acquired skills meaningfully.

Finally, investigation of the retention/relearning effects of different training strategies such as those employed by Irvin and Bellamy (1977) is important. Gold's (1972) results, and Belmont (1966) and Heremelin's (1967) conclusions from comprehensive reviews of the relevant experimental literature, all demonstrate that retention appears to be related to degree of original acquisition. However, it is impossible to ascertain whether Gold's (1972) retention effects were produced by a rigorous acquistion criterion or by a good amount of practice prior to initial acquisition. The Irvin and Bellamy (1977) sample offers an opportunity to investigate this confound because a heirarchy of efficiency of stimulus features manipulation strategies was demonstrated, with the most powerful procedure involving the least practice by trainees prior to acquistion to a rigorous criterion.

Method

Subjects

Subjects were 30 severely retarded individuals who had been trained to criterion on a bicycle axle/nut visual discrimination assembly task one year earlier (Irvin & Bellamy, 1977). Ten subjects were selected randomly from each of three different original stimulus features manipulation training groups consisting of 17 individuals. One original group had received training consisting of added and progressively reduced differences on the relevant shape dimension of the task. The second group had been trained via added and progressively faded color cues. The third group had received combined relevant-dimension cue-disparity and color coding/fading discrimination training. (See Irvin and Bellamy (1977) for a complete description of original sample selection, characteristics, and training.)

Materials and Apparatus

The apparatus consisted of a small plywood tray with two compartments open on the front and separated by a space in the middle. The materials for the criterion task were 10 Phillips bicycle front axle nuts and 10 bicycle axle posts. One face of the axle nuts was flat and the other was slightly raised (.10 cm).

Procedure

Subjects were required to assemble a bicycle axle and nut with the axle post inserted into the flat side of the nut. Each of the original training procedures had involved four phases, three training and one criterion task phase. Subjects in the current study were retrained on the criterion task only, *without color coding/fading or added/faded cue disparities*, approximately one year after original training.

The experimenter modeled the entire task and asked subjects to "do the rest." Measures of discrimination were taken at the point when the subject evidenced satisfaction with the position of the axle nut in the left hand by reaching for an axle post with the right hand. The experimenter provided verbal cues ("no" or "turn it over") and full or faded physical prompts to teach subjects the correct positioning of the nut after every discrimination error. Only one measure per trial was taken, subjects' responses to corrections were not scored. After every correct discrimination or completed trial, the experimenter said, "Good," "Excellent," "Yes," etc., and patted the subject on the back or arms.

As in the original acquisition training (Irvin & Bellamy, 1977), 20 consecutive correct discriminations constituted criterion retention (or relearning). Subjects were allowed 700 trials to achieve criterion. Dependent measures were trials- and errors-to-criterion. A complete description of the methodology used in the original training study is contained in Irvin and Bellamy (1977).

Results

Data on trials and errors were analyzed separately using two 3x2 (Original Treatment X Time) analyses of variance with repeated measures on one factor (Time of training—original vs. retention). No retention/relearning effects due to type of original training emerged for either trials- or errors-to-criterion. Likewise, no effects due to time of training existed for trials-to-criterion, and no interaction effects of any kind were present One reliable effect was apparent: errors-to-criterion increased between the original criterion task phase and the retraining of one year later ($F=4.7$, $p=.04$, $df=1,21$). Trial and error means and standard deviations for original learning and retention are presented in Table 1. These data are based only on those subjects who achieved the retention criterion; no meaningful scores could be assigned to others (two from the original relevant-dimension cue-disparity training group, three from the original color coding/fading training group, and one from the original combined technique group).

Table 1
Means and Standard Deviations (SD) for Trials and Errors for Original and Retention Performance

Original Training Group	Time of Training			
	Original Criterion Phase		One Year Retention	
Relevant dimension cue-disparity	$\bar{X}$ Trials	46.9	$\bar{X}$ Trials	68.1
	S.D.	38.3	S.D.	94.9
	$\bar{X}$ Errors	5.9	$\bar{X}$ Errors	20.9
	S.D.	7.4	S.D.	40.6
Color coding/fading	$\bar{X}$ Trials	46.9	$\bar{X}$ Trials	66.3
	S.D.	41.7	S.D.	38.2
	$\bar{X}$ Errors	7.3	$\bar{X}$ Errors	15.1
	S.D.	10.4	S.D.	10.0
Combined technique	$\bar{X}$ Trials	30.0	$\bar{X}$ Trials	83.3
	S.D.	9.8	S.D.	90.2
	$\bar{X}$ Errors	3.2	$\bar{X}$ Errors	25.0
	S.D.	3.4	S.D.	43.0

Discussion

In the results reported here, retention is suggested by the lack of experimental effect due to time of training—original vs. retention. That is, severely retarded individuals appear to perform about as well on a vocational skill task after one year without practice as they did during the criterion task phase of acquisition training as measured by trials-to-criterion. It should be emphasized that trials on the criterion task phase during original training do not reflect total original training trials; this phase was the last of four training phases for each subject. Gold (1972) demonstrated remarkable retention effects when redundant color cues were used as training aids during both acquisition *and* retention/relearning training, i.e., trials and errors were significantly and substantially fewer at retention than at original acquisition. The current results extend this finding in one important way: severely retarded individuals exhibit substantial retention of a difficult visual discrimination involved in an assembly task, after one year without practice *and* in the absence of redundant cues employed during original acquisition training. The mean number of trials required for retention/relearning across original training groups was 73.3, which required about 20 minutes of training. The retention/relearning of newly acquired skills that have no apportunity for regular expression, a critical component of prevocational training, appears within the capabilities of severely retarded adults.

It is not possible to conclude from the current results that any of the three stimulus feature manipulation strategies resulted in superior retention/relearning. It appears that training procedures can employ any method of stimulus feature manipulation to facilitate acquisition, without concern for short-changing degree of original learning, as long as, during acquisition training, such procedures are gradually faded and acquisition criteria are stringent.

The one significant effect in the current study, an increase in errors-to-criterion from original to retention training, requires some attention. Errors-to-criterion did increase significantly, but not to the extent that efficient relearning was precluded (as demonstrated by the trials data). Some increase in errors was expected due to the nature of the two training exercises. Original criterion learning was accomplished after three training phases where color or other cues existed to aid acquisition. By the time subjects reached the final criterion task phase, the task was familiar and effectively learned; trials and errors were minimized. During retention training, though, only the criterion task phase was encountered. Only through errors could subjects receive information (trainer verbal or physical prompts) to aid performance. Such results are consonant with the rather consistent finding that some increase in errors occurs when fading procedures eliminate all redundant or exaggerated training cues (Moore & Goldiamond, 1964; Sidman & Stoddard, 1967; Touchette, 1968).

Overall, the findings are of considerable importance for "prevocational" programs which cannot predict the vocational demands which might later be placed on trainees. In such a situation, it could be appropriate to teach skills associated with the widest possible array of vocational tasks, in order to increase the likelihood that some skills relevant to any specific job would be acquired.

Of course, teaching specific skills which are retained is only one component of effective prevocational programming. To the extent that the term "prevocational" refers to skills which increase the probability of success in later vocational settings, general components of an effective prevocational strategy should be identified. These include identification of the wide variety of specific skill requirements encountered in vocational settings in which the individual might be placed, and then the teaching of these skills directly (the visual discrimination taught in this research would exemplify this kind of "prevocational" training). Other prevocational skills are more general in nature, and include skills that can be used across many tasks (e.g., generalized tool use abilities) and skills involved in obtaining information from a trainer or supervisor (e.g., following detailed verbal and written instructions, generalized imitation of fine motor responses, and the ability to follow picture or match-to-sample cues. The current demonstration of the retention of severely retarded adults in a vocational training context should provide additional impetus for defining components of an effective prevocational training strategy.

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